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THE UNKNOWABLE;

OR,

THE RELIGION OF SCIENCE.

By RICHARD A. PROCTOR.

EARLY RELIGIOUS IDEAS: THE HUNTER—THE HERDSMAN.

IT would be easy to write a volume about the religious ideas of savage races. Tylor, Lubbock, and many other writers have collected multitudinous evidence to illustrate savage beliefs. Here I propose rather to present the results to which such accumulated evidence clearly points, and to show how such results correspond with the views to which *d priori* reasoning as clearly tends, than to fill page after page as I easily might, with quoted evidence. But I may remark that some of the matter recorded in these pages under the head of "Indian Myths" may be regarded as affording a very suitable, and sufficient illustration, though presenting the beliefs of only one race among one class of savage tribes.

We must regard the lowest class of savages as those who live either by hunting and fishing, or on the wild fruits of the earth, having neither flocks and herds to supply them with food, nor cultivated land to give them crops of various sorts in the proper seasons. Thus the earliest recognition of existences and forces outside himself came to men trusting to the wild products of the earth or entering into the struggle for existence with creatures scarcely wilder than themselves. It might seem that all traces of religious ideas having their origin in that remote time (for each now civilised race) when the progenitors of the race were thus slightly advanced beyond wild animals of the woods, could have left no traces on the religions of civilised races in our day. But no ideas and no customs are so long-lasting, as those associated with man's fates and fortunes as affected by external influences,—and in such ideas and such customs all religions had their origin. So that, as we shall presently find, not only the superstitions, but even the religions of to-day, bear traces of such notions as naturally sprang up among races living by agriculture, among earlier races trusting chiefly to pasture, and so backwards into time among races trusting wholly to the wild products, animal and vegetable, of land and river and sea.

That in the vegetable world those wild savage ancestors of ours should have found evidence of power and will, such as each individual man had learned to recognise in himself was natural. The tree which brings forth fruit, the herb, yielding seed, held later to be created things, were self-existent individualities to the earlier savage,—as they now are to many children, perhaps would be to all if left untaught. The rain which nourished vegetation, and the cloud from which the rain fell, were probably not so early regarded as powers, though they certainly came to be so regarded later. Vegetation must also early have been regarded from the point of view of the hunter. When the animals he pursued were sought in their lairs in grass or bush or tree, when in the pursuit of such animals vegetation in various forms seemed to afford either protection to wild creatures or assistance to the huntsman, then the idea of innate force in trees and shrubs would naturally arise. So also to the fisherman would the river seem a power,—as indeed it would appear, though in another way, to the hunter. Snow and wind, thunder and lightning, land and sea and sky, would ere long take their place among the existences and the powers which man in this earliest stage of savage life would recognise as influencing his fortunes.

But still more especially would various animals come to be recognised as having powers akin to man's own—nay in some cases greatly exceeding his. There would be the animals who took part with him in preying upon others,—the lion, the tiger, the bear, the crocodile,—mightier hunters than man, often making man himself their prey, and only to be overcome by men when many joined in the assault. There would also be those whose craft seemed so great that man had but small chance of capturing them for prey. There would be those—like the elephant, the hippopotamus, the rhinoceros, and the bison—whose ponderous strength secured them from attack. And lastly there would be others which, though weak and simple, were endowed with such agility, such keen senses, or such other protective properties, as often to elude the pursuit of even the keenest and most active huntsmen.

We can understand that in the struggle for existence, the peculiarities of such races of animals as had chiefly to be considered, whether because of their destructive or their self-preserving powers, would be keenly noticed. The fortunes of the huntsman, varying in a hundred ways with varying circumstances, would be associated with the various animals affecting them, in such sort as to suggest the idea of powers to be feared and to be propitiated. Often mere chance events would suggest the idea that some animals were lucky and some unlucky, or rather that some were of evil others of good influence. And by the way, we may be well assured that very early the serpent would be recognised by the hunter, even though he did not pursue it for food, and were not molested by it, as more subtle than any beast of the field.

Along with the growth of such ideas as these would proceed the development of the idea of a second self in each human being,—a conscious entity independent of the body,—an entity whose beginning was a mystery and whose end seemed no more likely to have come with the death of the body than it had come with sleep or trance. We can understand, then, how there would arise quite early the idea of a second self other than the visible form, in tree, shrub, and animal. We can see also how the idea would almost simultaneously arise that the second self in animals and trees, in earth and sea, in sky and in river, in rain, wind, lightning, and thunder—might not only be akin to the human second self, but might absolutely be human. The thought that when man dies his other self remains, would not long remain separate from the thought that power will and intelligence, akin to those of the human soul, may exist outside man. From the association of these thoughts would arise the belief that the souls of the dead animated the various natural objects on which the fortunes of the

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savage hunter and his family—nay on which his life and theirs—seemed to depend. Belief in the transmigration of souls from animal to animal and from animal to man—would seem naturally to belong to this early stage of thought. But, as a matter of fact, men seem to have been more prone to consider the probable *future* of the second self of men who had lived, and especially of those who had seemed exceptionally fortunate, than to inquire into the past of that other self,—even as, in our own time, and among the most religious peoples, belief in the immortality of the soul continues one-sided, directed wholly to the future and having no reference whatever to the past.

So long as man continued to trust solely or chiefly in the natural fruits of the earth or in such food as he could obtain by hunting and fishing, his ideas of the existence outside himself of something akin to what he found in himself "welling up as consciousness" would be limited to the natural objects of various orders, the natural forces and processes of various sorts, which influenced his fortunes. With regard to clothing, as probably the earlier races of men lived where clothing was little needed—at any rate for their hardy frames, still in large degree clothed with hair where now only down attests the former hairiness of the human body—we may believe that any such artificial clothing as he began to require he would obtain from the skins of animals and the leaves of trees. The struggle for existence would not depend in such degree on the securing of such artificial clothing as to affect his ideas about existences outside his own. Man would in those early times be naked without much suffering, and certainly without being particularly ashamed.*

As the pastoral life gradually encroached on the life of the fruit eater, the huntsman, and the fisher, new recognitions of external influences would be introduced. The calf and the lamb would be more important to pastoral races, than the deer or the antelope. The regenerant powers of nature would have deeper interest than they had had of yore. Yet the influences of air and rain and sky would still be recognised,—nay they would be now recognised more clearly than when the comparatively rough and brutish huntsman faced with little concern the fury of the storm and the conflicting powers of the elements. Moreover the fiercer animals would still represent forces to be feared or to be propitiated. The bear and the lion, the wolf and the crocodile, especially if by this time they had been regarded as tenanted by human souls, would be regarded as requiring perhaps more than mere observance and respect—sacrifice would be offered to them. Nay sacrifice offered to some of the fiercer animals of prey would not be offered wholly in vain, vain though the belief might be that those animals were tenanted by human souls. For flocks and herds might be saved by well-devised sacrifices of calves or lambs. It is even conceivable that what was thus done originally with design belonging only to pastoral wisdom, might have been the beginning of sacrifices offered later with religious intent. Assuredly a custom so begun would develope in the fulness of time into a religious observance. So that we may put as among the quite possible causes of this special class of sacrifices—and therefore possibly of all sacrificial observances—a practice which men living by flocks and herds, such races "as dwell in tents and have cattle"—had found effective to save many by the sacrifice of a few.

Probably the observance of the heavenly bodies would have begun with the pastoral stage of the particular race or races of men from whom the religions in which we are chiefly interested had their origin. I believe that the full faith in the influences of the sun moon planets and stars, the clear recognition that they are for signs for seasons and for days and years, belonged to a later stage of development. But we can hardly imagine that pastoral races would long have failed to observe the stars in their courses, or observing them have long escaped the thought that on their motions depend the fortunes of their herds and flocks. In the first place the life of the herdsman, unlike that of his predecessor the huntsman, was one specially requiring nightly watch. It is not a mere vague fancy or an idle tradition that races which of old "watched from the centres of their sleeping flocks" were the first astronomers, or that they early recognised in the planets, orbs like radiant messengers, that seemed to move as though "carrying through æther in perpetual round," the influences and almost "the decrees and resolutions" of external powers.

Thus as the calf (witness the golden calf for worshipping which the Jewish people were punished) and the lamb became early religious emblems, so we find among the most ancient objects pictured by men's fancies in the heavens, those animals in which the shepherd was especially interested. There we find the Ram and the Bull, the Waggoner bears on his shoulders the two Kids, the Herdsman with uplifted arms (well seen in the heavens even now, though no longer existing in star maps) drives away from his flocks the Bear and the Lion, the creatures which as we know were most dreaded by the shepherds of oriental countries.

We cannot doubt that at this stage of man's development the movements of the sun and moon would be noted, though as yet perhaps the sun would be but slightly considered. The moon would acquire at this early stage the character which was afterwards more distinctly recognised in her,—that of the measurer of time, a character indicated in the name which all eastern races gave to her. She was described indeed by two names, one indicating measurement the other light, and among the Greeks the former was scarcely ever used, while among the Romans it was altogether lost except in compounds relating to the month; but in older languages the measure name of the moon was the chief, in some cases the only one, and it still remains among ourselves. To pastoral races the moon's value as a time measurer would obviously be great. To this day

* It may indeed be said,—I offer the idea as suggesting a new symbolical interpretation of the history of Adam and his family—that Adam may be regarded as before the fall typifying savage man living simply on the fruits of Nature's garden; while after the fall he typified man living alike on the fruits of the earth and on his fellow animals. Abel the next man may in like manner be regarded as typifying pastoral races,—and Cain the third as typifying races which later lived by agriculture, from whom descended fresh pastoral races of the nomadic sort, and later civilised races, artificers and artisans as well as races possessing artistic skill. We should escape thus—if we conceive escape to be necessary—from the unscientific and in reality inadmissible idea that all pastoral races descended from Jabal, all agricultural races from Cain, all artificers from Tubal-Cain, and "all such as handle the harp and pipe" from Jubal. Such accounts, interpreted literally, are fit only for children or for child races. Interpreted symbolically and allegorically, they need not be regarded as necessarily more inadmissible than the seeming accounts of nations being descended from a single pair (even the whole human race as so descended), accounts which as interpreted literally could only have had their origin among men ignorant alike of biological and physiological laws. Men who view the bible account as expressing simply what the wisest men of those unlearned times thought about such matters, need not be at the pains to sift out the symbolical from the literal. For them the record as it stands is full of interest in many ways; but in its freedom from all effort to introduce later knowledge into a very ancient attempt to solve the mysteries of existence—it is especially interesting to the student of the past of religion.

the times of calving and lambing are measured among countrymen by moon circuits. In pastoral life, again, began the practice of hiring labour; and we know that from the very beginning labour was hired by the month and by the week, that is by direct reference to the moon, a practice which has reached to our own time, and probably will last so long as the human race endures upon the earth.

But it was not until agriculture began to replace pasture, as pasture had replaced hunting, that the heavenly bodies of various orders, and the sky which held them, became the objects of special attention,—merging gradually into veneration and into adoration. The beginning of the actual ceremonials and theologies of our day must be referred to this stage of human progress. It may well be that much even of the theological doctrine of our time, and it is certain that much of its ceremonial observance, must be referred to the time when first men began to till the earth for their subsistence. The evidence on this important part of my subject comes next then to be considered.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

IV.—THE PAST LIFE-HISTORY OF THE EARTH.

GEOLOGY deals with the stuff of which the earth is made, with its origin, structure, and arrangement. But so inter-related is the material of which all things are spun that inquiry into the structure of rocks has to be extended well-nigh at the outset to their contents—that is, to the fossil forms or imprints of ancient life which are not only preserved within the larger number of strata, but which entirely compose vast masses, as in the coal-measures, chalk hills, and coral islands. Therefore the interest which the study of the earth's crust, of its erupted, fire-fused, and water-laid rocks, awakens, especially in their witness to ceaseless changes through an ever-receding past, becomes more immediate and human when the relics of ancient life-forms are examined, and their appearance, persistence, or disappearance; their order and succession in an ever-varying, ever-ascending scale, traced. For in them lies the record of *life* on the earth through measureless time, the life that was, parent of all life that is; from simple slime-speck to structure of subtlest complexity named man, with its passionate story of agonies and joys, of struggle towards a kingdom of heaven yet unentered.

True it is that the record is very imperfect, that the gaps remain wide and numerous even when supplemented by remains from other parts of the globe. But the wonder is that the blanks are not greater, when the nature and extent of the changes to which all rocks have been, and are being, subjected are considered. In addition to the havoc and effacement wrought by the earth's internal heat, and by divers agencies to be dealt with in due course, the formation of every deposit involves the waste of an older deposit, which has in its turn been derived from more primitive stuff, the effect throughout being injury to, or destruction of, the organic contents. It is impossible that the vast number of lowest life-forms, whether plant or animal, should have been preserved. Traces of marine organisms survive in the trails and borings of sea-worms, or in the imprint of carcasses of jelly-fish stranded on the ripple-marked mud of ancient sea-shores, but of the soft-bodied creatures themselves not a vestige remains. Only the hard parts of animals and plants; shell, skeleton; wood, bark, seeds; would reach the fossil state in more or less perfect form, and even their preservation is contingent upon the nature of the beds in which they are interred. As it is, but a remnant of all that ever lived in the water, and a far less proportion of the smaller population of the land, are represented in actual fragments. Sometimes only an impression survives, as when a dissolved shell has left its witness in cast or mould in clay or mud, or an extinct bird or reptile its foot-prints on the sands of a far-off time. Sometimes, in the compensating action of nature, chemical agents, in destroying the original structure, infiltrate the vacancy with minerals, replacing the form, occasionally in minutest detail.

Rich as are igneous rocks in wealth-yielding mineral veins and ores, they are, save where recent plants and animals have been accidentally enveloped in the flowing lava or dust of volcanic eruptions, destitute of fossils. There was a period in the earth's history when life was not, and its beginnings, which were probably in north polar regions, were certainly subsequent to the ejection of the molten or pasty masses which cooled into true volcanic or fire-formed rocks.

Fossils are found only in sedimentary rocks, although not universally in these, many of them having no organic remains. Varied and mixed as they are in composition, their specific names and differences need not be detailed here, and it suffices to group them under two heads—namely, those derived from sediment in its several states of gravel, sand, and mud; and those formed of the remains of plants, as coal in its several stages from peat to the hard graphite or black-lead of the older formations; or of the remains of animals composing chalk, limestone, and other organically-derived rocks. But whatever their source, and however much the original order of strata has been deranged by hidden agencies which have tilted them at all angles, cleaved and contorted them, and superposed the older on the newer, there is a well-ascertained succession in them which their fossils alone have enabled us to determine, each formation having its own characteristic kind or dominant type of animal and plant. Not that there are any hard-and-fast lines between the disappearance of an earlier species and the appearance of another, the forms being often commingled. Some of the low and simple types persist through almost all formations, some of the more complex are found in only one or two formations, but there is a merging of one into another; there are gradations and alliances of type, as of birds with reptilian characters and *vice versâ*. And although seemingly isolated types occur, or the divergence between earlier and later types has blurred their relation, it will be seen that the modern are the ancient slowly and wondrously modified. In short, the life-history of the globe is one both of unbroken relation and progress.

Before summarising the formations and their typical fossils, the order and nature of past life-forms, more especially in their relation to present life-forms, will be made clearer by the accompanying schedule of the sub-kingdoms into which existing plants and animals are divided, beginning in each case with the lowest. For it will be seen that these divisions apply to fossil plants and animals, since they conform so completely in structural plan to the types represented in the several sub-

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kingdoms, that there is no known fossil for which a new sub-kingdom is required :—

I.—PLANTS.

Sea and other Water-weeds (*Algæ*), Lichens, Fungi	Gymnospores, *i.e.* naked spores.
Mosses, Ferns and Horsetails, Club Mosses	Angiospores, *i.e.* enclosed spores.
Pines and Palm Ferns (many seed-lobes)	Gymnosperms, *i.e.* naked seeds.
Grasses, Sedges, Palms (one seed-lobe); Trees, Shrubs, Herbs (two seed-lobes)	Angiosperms, *i.e.* enclosed seeds.

II.—ANIMALS.

1. Invertebrates, *i.e.* without backbone.

Monera* (gr. *monos*, single)	Structureless, sticky, alike all over.
Amœbea* (gr. *amoibe*, change)	Slight unlikeness of parts; always changing shape.
Foraminifera (Lat. *foramen*, an opening)	Secrete shell or skeleton of lime from water. Show passage to further unlikeness in parts.
Polycystina (gr. *polus*, many, and *kustis*, a cyst)	Secrete shell or skeleton of flint from water.

Sponges.
Coral-animals, anemones,* jelly-fish.†

Sea-lilies, star-fish.

Worms of all kinds.
Crabs, spiders, centipedes, insects (Crustacea).

Sea-squirts. (Ascidia)
Oysters, snails, cuttlefish } Mollusca.

2. Vertebrates :—

A. *Pisces.*
Lancelet (Amphioxus).
Fish of all kinds.

B. *Amphibia.*
Toad, frog.

C. *Reptilia.*
Serpent, lizard, crocodile, turtle.

D. *Aves.*
Birds of all kinds.

E. *Mammalia.*
1. Aplacental (bringing forth immature young). *Monotremes*, or one-vented; duckbill; spiny ant-eater. *Marsupials*, or pouched; kangaroo, opossum.
2. Placental (bringing forth mature young):—Ant-eater, manatee; whales and porpoises; horse and all other hoofed animals; elephant; seal, dog, lion, tiger and all other flesh-feeders; hare and all other gnawing animals; bats; moles and all other insect-feeders; apes; man.

The following sub-divisions of the stratified rocks indicate the order of their succession. There is no one section of the earth's crust where a complete series is to be found with layer superposed on layer like the skins of an onion; but whatever gaps exist locally do not affect the relative age and place of each stratum which, as noted above, are fixed by the fossils :—

Epoch.‡	Systems.
Archeolithic and Primary	Laurentian, Cambrian, Silurian, Devonian or Old Red Sandstone, Carboniferous, Permian.
Secondary or Mesozoic	Triassic, Jurassic or Oolitic, Cretaceous.
Tertiary or Cainozoic	Eocene, Miocene, Pliocene.
Quaternary or Post Tertiary	Recent (Pre-historic, Historic).

Before passing to a rapid summary of the leading fossil contents, it may be remarked that no uniform principle has governed the choice of their system-names. Sometimes they indicate the place where a system is markedly developed, sometimes the typical features of the system, but they are the accepted nomenclature in all treatises on geology, and are therefore adopted here.

The *Laurentian* rocks, vast and venerablest sediments of primeval seas, are highly metamorphic. Heat, moisture, and enormous pressure have changed their sandstones into sparkling crystalline rocks, their limestones into veined and variegated serpentines. Formerly they were classed as "Azoic"—*i.e.*, without life—but of late years those which form the Laurentide mountains in Canada, whence the general name of the series, have acquired special interest from the discovery of certain veined structures in them which, on balance of evidence, are pronounced to be the remains of a marine animal, very large of its kind, related to the group of the Foraminifera, which possess the power of secreting lime from the water, and forming therewith perforated shell-coverings of exquisite symmetry and beauty.

Certain members of these lowest life-forms might smile at man's "claims of long descent," for they have survived through the long and change-bringing millions of years to this day, shedding their shells on the deep ocean floor, as their ancestors shed theirs and built therewith the vast chalk and limestone hills and mountain ranges in relatively shallow seas. While some secrete chalk, others secrete flint, among which last are the minute plants known as Diatoms, whose remains compose, among other deposits, the "rottenstone" used as polishing powder, with little thought on our part that no less than forty-one thousand million skeletons go to make up a single cubic inch.

Even if the organic character of *Eozoön Canadense* were disproved, and we do not witness in it, as its name implies, the "dawn of life," abundant traces remain that the Laurentian waters teemed with living things. For the limestones, the abundant graphites, and the great beds of iron ore which occur in its rocks, are due to the action of animal and plant life.

The *Cambrian* rocks, which are less metamorphic, add little to our knowledge of primitive plant-forms, such as are preserved being probably Algæ, or sea-weed, corresponding to the tangles covering large areas of the Atlantic, especially the Sargasso Sea. But the system is fairly rich in fossils of marine animals, themselves the descendants of a long line of perished ancestors. Sponges, sea-lilies, and low forms of mollusca or true shell-fish are found; but the typical and most perfect fossil is that of the three-lobed crustaceans called trilobites, which swarmed in those ancient seas, and survived till the Carboniferous period.

The *Silurian* rocks, though exhibiting in crumpled and rugged mountain-chains the action of agents both above and below the earth, are much less metamorphosed than the preceding systems. They are in large measure the worn fragments of land-areas which stretched across northern Europe for above two hundred miles into the Atlantic, the sediment being deposited in a shallow sea which then covered central and southern Europe, and the floor of which was slowly raised as a primitive European continent at the close of the Silurian period by subterranean movements. The most interesting land fossils are those of plants allied to huge club mosses, ancestors of the gigantic forest-kings of Devonian and Carboniferous times, while the marine remains are varied and numerous, comprising seaweeds, foraminifera, corals, starfish, shell-fish of every kind, trilobites, and with these huger lobster-like crustaceans, sometimes measuring above six feet in length.

* No fossils of these soft-bodied lowest forms exist.
† Impressions of bodies only.
‡ Vide Knowledge, January, p. 78.

But the most important fossils are those of the earliest-known and lowest class vertebrates in the form of armoured fishes, allied to our sturgeon, and called ganoids (Gr. *ganos*, splendour; and *eidos*, form), from the brilliancy of their enamelled scales.

In this seemingly sudden appearance of highly-organised animals marking so great an advance in structure on the higher invertebrates, the imperfection of the geological record is brought home to us. If later forms are modified descendants of earlier, then not only are the transitional ancestral forms of the ganoids missing, but the species itself is much older than the fossils imply. The inquirer need not despair; for only a limited portion of the dry land has as yet been explored, and there are vast fossil-holding areas submerged and inaccessible; yet one by one missing links are being found, and if the ancient intermediate forms, with their shorter life-span, between the higher mollusca and the lowest vertebrates, elude us, fortunately there are extant organisms through which the connection can be traced.

In this brief survey of the three earliest systems we have already traversed more than half the total thickness of the fossiliferous rocks, the deposit of which involved a lapse of time and series of changes of which no conception is possible. The base-line of our life is too short for measurement of the distance which separates the foraminifera from the ganoids; of time, as of space, we see neither beginning nor end.

HISTORICAL PUZZLE.

BY RICHARD A. PROCTOR.

ONE of the most remarkable problems—one might almost perhaps say puzzles—of history, is the entire absence of any reference by Josephus to those events which according to the gospels took place in Jerusalem during the years which preceded his birth. He was regarded by his contemporaries as a sagacious, careful, and well-informed man, especially in regard to the history of his own country, and still more especially of Jerusalem during the century preceding the capture of that city. His father resided in Jerusalem throughout the whole time covered by the life of Christ according to the narrative of Matthew (that is from B.C. 4, determined from the death of Herod the Great, to A.D. 33) or according to Luke (that is, from A.D. 9—the taxation by Cyrenius—to A.D. 33) or according to the narrative of John (which, if the remark "thou art not yet fifty" be taken in its natural sense would be different from either). It is evident, independently of the evidence of Josephus, that his father, and the whole family, were in a position of dignity, while also in such a position that they could not but hear of everything of interest which happened in Jerusalem, or indeed anywhere in Palestine. It is absolutely impossible that they could have remained ignorant of the strange events which took place in their own time and country, events which we are told moved even the most conservative minds to recognise that a man of marvellous powers as well as of profound insight and of singularly pure and blameless life, was in the land. At the time when the whole city of Jerusalem was stirred either to sympathy with Christ and his followers, or to anger against them, when the powers of nature were moved, insomuch that the sky was darkened, while the graves opened and gave up their dead, who going about were seen of many, the family of Josephus must have been among those who marvelled at these strange events and were terrified by such tokens of divine displeasure. That a man so careful to collect even the most minute details about these very times, having access to all the public records (even to the sacred records of the priesthood), to the evidence of all the leading men and families, and who lastly must repeatedly have heard the members of his own family speaking about these marvellous yet well-known events, should have either overlooked them or thought them not important enough for mention, must be regarded as utterly incredible.

Yet Josephus, as is well known, says nothing whatever, either about John the Baptist, or about Christ, or about the Apostles or disciples of Christ. So remarkable did this silence seem to the early Christian writers, that after Photius had dwelt upon it in his articles on Josephus, a passage was interpolated relating to John the Baptist; and after Origen (taking the interpolated passage as genuine) had dwelt on the still more striking circumstance that Josephus referred to John the Baptist but did not refer to Christ, another passage was interpolated in which Josephus appears to refer to Christ in terms implying that he regarded Christ as the promised Messiah. Although in those uncritical days this forgery passed muster, as did many much more glaring, yet now no critic of repute admits this incongruous paragraph (clumsily inserted where—if Josephus could have written it—he assuredly would not have placed it) as genuine. As Bishop Warburton said, it was clearly "a rank forgery and a very stupid one too," and "it has long been given up," says De Quincey, "as a forgery—by all men not lunatic." Those who introduced it had pious intentions, no doubt; but they were apparently not conscious of the bad effect its appearance would have, after the regrets expressed by Photius and Origen in regard to the absence of any reference to Christ in Josephus's works. It was much the same in this case, as with the addition to the Annals of Tacitus of a passage relating to persecutions of Christians by Nero (at a time when according to the Acts of the Apostles the Christians were left in peace) though the early Christian fathers who had ransacked Tacitus, Suetonius, and every Roman writer, for just such passages, had failed to find anything of the kind in those works as known in their day. Such forgeries, as Bishop Warburton implied, were most mischievous as well as most unwise, however they may have commended themselves to men of the type of the Christian historian Eusebius, who expressly taught that "falsehood may be employed by way of medicine for those who need it," and boasted openly that he had "related all which might redound to the glory and suppressed all that could tend to the discredit of our religion."

Canon Farrar, in his "Life of Christ," takes at once a bolder and a wiser course in regard to this historic puzzle. "No one can doubt," he says, "that the silence of Josephus on the subject of Christianity was as deliberate as it was dishonest." "The probable reason of this silence," he remarks further, "is that Josephus, whom, in spite of all the immense literary debt we owe to him, we can only regard as a renegade and a sycophant, did not choose to make any allusion to facts which were even remotely connected with the life of Christ."

This of course explains the whole matter, as completely and unanswerably as what is sometimes ungallantly called "a lady's reason." If Josephus was silent on the subject of Christ because he did not choose to speak, it might seem that there is nothing more to be said.

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But the dishonesty of this renegade from Christianity, (this sycophantic "Hellenising courtier" who was in favour both with Vespasian and with Titus, and was even suspected of being able to obtain favours for his countrymen from both emperors, father and son) so soon as it is admitted in interpretation of this remarkable historical puzzle, may perhaps explain other singular features of Josephus's writings. He seems to have been not only dishonest, a renegade, and a sycophant, but a singularly bold yet crafty plagiarist. Unless we admit the occurrence of a series of accidental coincidences, highly improbable as such, we shall find that Josephus adorned his narrative (which he pretended to advance as "neither hiding nor adding to the known facts," and which he challenged all men living in his day to contradict if untrue in any particular) with events, characters, and descriptive passages manifestly stolen from the gospels, or from some earlier Christian gospel, known to him, but which has not descended to our time.

It need hardly be noted, except as belonging to the evidence of Josephus's guilt, that he ascribes to a religious sect among the Jews, already numbering, he says, 4,000 persons, the doctrines which were actually taught by Christ and his apostles—for this of course is well-known. De Quincey, indeed, strove to show that the members of that sect were in reality early Christians. But it is far easier to suppose that Josephus found in Christian doctrines materials for an interesting paragraph, while, by avoiding all mention of the author of those doctrines, he helped to carry out the deliberate and dishonest purpose attributed to him by Canon Farrar.

Josephus referred to a Galilean (and Christ we know was regarded as a Galilean) who taught new doctrines, insomuch that his followers "did not value dying any kind of death, nor indeed did they heed the deaths of their relations and friends, nor could any such fear make them call any man lord."—"Nor am I afraid," he proceeds, "that anything I have said of them should be disbelieved, but rather fear that what I have said is beneath the resolution they show when they undergo pain." He calls the founder of this sect Judas; but naturally his dishonesty would lead him to alter the name.

Josephus describes how a certain man promised great things to the Samaritans, insomuch that they followed him to Mount Gerizzim in great multitudes,—but Pontius Pilate, he says, prevented their going up, and ordered the death of their leader. For this, he says, Pilate was presently blamed, and had to go to Rome to defend himself before Tiberius—but Tiberius was dead when he reached that city. He doubtless put this story into his narrative to give another aspect to what he must have known was the real murder for which Pilate, in the last year of the reign of Tiberius, fell into trouble.

Josephus describes one named Jesus, who long after the events recorded in the Gospels, displayed some of the most marked characteristics ascribed by the evangelists to Christ. This man proclaimed woe to Jerusalem, sorrowfully yet steadfastly, for several years. This Jesus, "a plebeian," says the historian, "four years before the war began, and at a time when the city was in great peace and prosperity, came to that feast whereon it is our custom for every one to make tabernacles to God in the Temple, and began on a sudden to cry aloud, 'A voice from the east, a voice from the west, a voice from the four winds, a voice against Jerusalem and the holy house, a voice against the bridegrooms and the brides, and a voice against this whole people.'" When the most eminent conceived great indignation against him, and gave him many stripes, "yet did not he either say anything for himself, or anything special to them that chastised him, but still went on with the same words as before." Hereon the rulers of the Jews brought him before the Roman procurator, as "a man possessed with a divine fury"; whereon "he was whipped till the bones were laid bare; yet did he not make any supplication for himself, nor shed any tears," but cried only "Wo, wo, to Jerusalem." Thereafter till the end came (when with a loud cry, "Wo, wo to myself also," he met his death), "he did not give ill words to any of those that beat him every day"—but his reply to all men was the same lamentable cry, "a melancholy presage," says Josephus, "of what was to come."

That Josephus dishonestly transferred—with such change as to partly hide his offence—events which really occurred earlier, to the time of the siege of Jerusalem, becomes clearer yet when we note further, that he tells us how, at the same sad time for Jerusalem—1, a heifer miraculously brought forth a lamb, "as she was being led by the high priest to be sacrificed"; 2, at the same time (the Feast of the Passover) a light shone round the altar and the holy house, so great that it appeared to be bright day-time; and 3, a star resembling a sword stood over the city. All these prodigies were manifestly suggested to him by the Gospel narrative. He also says that shortly before this time (about thirty-four years after the close of Christ's ministry) Zachariah the son of Baruch was murdered by the people in the very temple itself—as if with the manifest intention of casting doubt on Matthew's account of Christ speaking to the Jews of "Zachariah son of Barachiah," as one "whom ye slew between the temple and the altar." The evidence of deliberate purpose here is too obvious to be overlooked. It is singular, too, that in the account of the prodigies before mentioned, Josephus includes an event manifestly borrowed from what is recorded of Peter in Acts, chap. xii., when the iron gate opened of its own accord: for he tells us that the eastern gate of the temple, "which had with difficulty been shut by twenty men, and rested upon a basis armed with iron, and had bolts fastened very deep into the firm floor, which was then made of an entire stone, was seen to be opened of its own accord about the sixth hour of the night." "Now those," he proceeds, "that kept watch in the temple came hereupon running to the captain of the temple and told him of it; who then came up thither and not without great difficulty was able to shut the gate again." From Acts also, Josephus has manifestly borrowed the following: "Moreover, at that feast which we call Pentecost, as the priests were going by night into the inner temple, as their custom was, to perform their sacred ministrations, they said that in the first place they felt a quaking, and heard a great noise, and after that they heard the sound as of a great multitude, saying, 'Let us remove hence.'"

I could point to many other features which Josephus has but too obviously plagiarised (hiding the theft with greater or less craft and skill) from accounts which must have reached him respecting Christ and His apostles. In particular, his account of Banus (a Baptist as the name implies) is manifestly borrowed from the account of John the Baptist. He describes further a man named Jesus, (not the Jesus who proclaimed woe to Jerusalem) who had friends called John and Simon, and followers who were chiefly fishermen and poor people. This Jesus, according to his account was betrayed by one of his followers, and deserted by the rest. Seventy followers he had, Josephus says, who went with him from city to city, while he heard cases and delivered judgments.

But space would fail me if I should attempt to indicate all the material apparently borrowed by Josephus with the "deliberate dishonesty" ascribed to him by Canon Farrar, from the Gospels and the Acts, or from accounts of actual events described in those records. One circumstance only I must add to those already dealt with. It would seem even as though Josephus had heard the actual details of the conduct recorded of another Josephus—to wit, Joseph of Arimathea:—for after claiming to be what Joseph of Arimathea was, "a councillor, a rich and just man," he states that having on a certain occasion been sent by Titus to a village called Thecoa, not very far from Jerusalem, he saw on his return, among other crucified persons, three whom he remembered "as former acquaintances." "I was very sorry at this, in my mind," he proceeds, "and went with tears in my eyes to Titus and told him of them; so he immediately commanded them to be taken down, and to have the greatest care taken of them, in order to their recovery; yet two of them died under the physician's hands, while the third recovered." This, he would know well, would be understood by all readers of his time to indicate clearly that the two who died had merited their punishment, like the two thieves, but that the third was innocent.

It appears to me that the only other explanation which can possibly be suggested for these multiplied coincidences, would be that the Gospels themselves, being written a century later, as the author of "Supernatural Religion" considers to be proved, came to include accounts which had been handed down by tradition, but related to actual events as recorded by Josephus. This is the explanation suggested by Mr. Solomon in his work "The Jesus of History and the Jesus of Tradition." But this explanation besides being inconsistent with accepted views respecting the authenticity of the New Testament canon, does not accord well with the conclusion of Canon Farrar that Josephus was a renegade and a sycophant,—deliberately dishonest in regard to events which had taken place in the lifetime of his father and had closed but a few years before his own birth. One or other explanation we *must* take, it would seem. In what sort of favour, by the way, Josephus stood with Titus, is perhaps sufficiently shown by his action with regard to his crucified friends,—as described by himself.

COAL.

By W. Mattieu Williams.

BITUMINOUS SHALES AND THE ORIGIN OF COAL.

THE trial and controversy concerning the Boghead or Torbane Hill mineral was instructive, would have been more so had the scientific witnesses been heard. Commercially it is coal, simply because it has been bought and sold under that name, was thus dealt with when the bargain under litigation was made, but, if we are to admit the existence of such a class of minerals as bituminous shales, it certainly belongs to this class, regarded from the point of view of scientific classification.

One experiment that was made in Edinburgh at the time, but of which no account appears to have been published, is, I think, decisive. A piece of boghead was carved roughly to the shape of a man's head. This was put into a fire, all its hydrogen and carbon burnt out, and there remained a solid lump of baked earthy matter still bearing the shape of the original lump. The original material was evidently a shaley rock, impregnated *somehow* with bituminous matter. I place special emphasis on this word somehow, as it presents an interesting problem which a sound theory of the formation of coal is bound to solve. Why have we in so many instances distinct seams of bituminous shale and of true coal so near together—in some cases in actual contact? The Leeswood cannel seam, for example, rests directly on a floor of shale, and is directly topped by a roof of shale, both black and bituminous. The products of distillation are the same of both shales and the two intermediate seams of cannel, but the shales leave behind masses of incombustible stone, the cannel lumps of combustible coke.

Still, in this classification, as in so many others, an absolute line cannot be drawn. Generally speaking, true coal leaves, on complete combustion, from $\frac{1}{2}$ per cent. to 3 per cent. of powdery ash. True bituminous shales leave a massive ash varying from 75 per cent. to about 15 per cent. Boghead leaves $21\frac{3}{4}$ per cent.; the top shale of leeswood above 75. Besides these we have questionable coal, leaving 10 per cent. or thereabouts of ash in lumps that crumble easily. Referring to Cleggs' table of the analysis of 198 varieties of British coal, I find 24 containing between 5 and 10 per cent. of ash; 21 between 3 and 5 per cent. Only two contain as much as 10 per cent., 9 contain less than 1 per cent., and 119 from 1 to 3 per cent.

I state these figures because they have an important bearing on the interesting question of the origin or formation of coal. They demolish at once the prevailing theory that a coal seam is simply an ancient forest or a woodland marsh that has been submerged and buried where it stood.

No such forest, no such marshy woodland as we see so prettily displayed in the fancy pictures of the vegetation of the coal period could be formed without soil for the roots of the calamites, the sigillariæ, the lepidodendra, the stigmariæ, the ferns, &c., to grow in. A single generation of such reeds and trees, if thus buried *in situ*, would form but a few inches of coal; to produce a seam, many generations piled one above another are required, and each demands a soil. Conifera, such as described, cannot grow one on the top of another, nor in the purely vegetable soil formed by the decay of their ancestors.

The quantity of ash contained in our most abundant coals leaves absolutely nothing to represent the soil. The average amount of incombustible ash contained in the roots, stems, and leaves of forest trees, shrubs, and herbaceous plants is actually in excess of that found in ordinary coal. Dried ferns contain above $3\frac{1}{2}$ per cent. of such ash; the leaves of beetroot (the ash of which is commercially used in the manufacture of potash) contains $10\frac{1}{2}$ per cent. Forest trees taken bodily, wood and leaves, vary from 1 to 6 per cent., the leaves always containing the most. Compare the ash left by a burnt cigar with that of a similar weight of coal when all the carbon is fairly burnt away. The calamites of coal measures represented by our "horse-tails" and "mare's-tails" have a siliceous scale armour, are exceptionally rich in ash. I have made microscopic preparations of these by burning a piece of the stem, and transferring the siliceous skeleton, without breaking it, to a glass slide, whereon it displays very beautifully the structure of the plant. Dried stems of such reeds are sold under the name of "Dutch rush," and used as natural files, for which purpose they are qualified by their flinty cuticle. I am unable to find any record of an analysis which gives the

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percentage of ash in these plants, but will determine it myself, and state the result in my next paper.

I must here warn the reader against a fallacy usually implied, though not definitely expressed in our geological text books. Pictures are there shown of the calamites, the sigilaria and stigmaria, the lepidodendrons, tree ferns, &c., of the coal measures, and the reader who only learns from books, without actual field-work, concludes when Lyell tells him that "no less than 250 ferns have already been obtained from the coal strata" ("Elements of Geology," 5th edition, p. 467), that coal itself has been proved to be made of these, that ordinary coal is visibly composed of such fossil vegetation, and that the pictures represent fossil specimens found in the coal itself.

This is not the case; *ordinary* coal displays little or no definite vegetable structure. It is true that Professor Göppert found in certain samples of German coal indications of structure corresponding to the fossil plants known as those of the coal measures, but the fossils which are pictured and described in the books are those found in the rocks above or below the actual coal seams, not in the coal itself. Thousands of years may have elapsed, must have elapsed in some cases (such as the celebrated fossil tree in Cragleith quarry), between the deposition of the coal itself and that of the fossil plants in the other rocks. Great geological changes must have occurred in order that pure vegetable matter, deposited where it grew, should be succeeded in the same place by a subaqueous deposit of sandstone, fifty or sixty or more yards in thickness. All this sandstone was certainly formed under water, and that water must have been deeper than its own thickness. If the coal was formed on the land, it must have been submerged either by a great convulsion or a series of ordinary changes extending over a vast duration of time, before the great sandstone or shale deposit could be formed over it.

The same reasoning applies conversely to the fossils found in the rocks below the coal-seams. Many of the coal-fossil specimens in our museums have come from rocks that are as much as 100 ft. above or below any workable coal seam. I once collected a cart-load of fine specimens from the materials of a sinking in Flintshire which failed to reach the coal.

I do not, however, assert that vegetation corresponding to these fossils found in the rocks have not contributed to the formation of the coal itself, but that the conditions of their deposition were quite different from that of the coal seams, and that they represent only those particular species of plants that are capable of retaining their structure under the circumstances of deposition. In the rocks where these fossils occur there are ten thousand or more parts of mineral matter to one of vegetable matter. In the coal there are forty or fifty of vegetable matter to one of mineral—less mineral matter than is found, on an average, in living plants.

Lyell struggles with this difficulty by supposing that our coal measures have "originated in the manner of modern deltas." He says, "They display a vast thickness of stratified mud and fine sand without pebbles; and in them are seen countless stems, leaves, and roots of terrestrial plants, free for the most part from all intermixture of marine remains, circumstances which imply the persistency in the same region of a vast body of fresh water."

But how about the absence in the coal itself of this mud and sand, the mineral sediment which makes up the substance of ordinary "modern deltas"? The explanation offered by Sir Charles Lyell, who always reasons on the sound principle of explaining the unknown by the aid of the known, is derived from what actually occurs in the valley and delta of the Mississippi, where the dense growth of reeds and herbage which encompasses the margins of forest-covered swamps, "is such that the fluviatile waters, in passing through them, are filtered and made to clear themselves entirely before they reach the areas in which vegetable matter may accumulate for centuries, forming coal if the climate be favourable."

Here he supposes (as he states further on) that the coal was formed actually on the spot where the vegetation grew; this brings us back to the difficulty I have already stated—viz., the absence of the mineral matter demanded as soil for the plants. How many generations of trees would be necessary to cover the ground closely together so as to form a stratum only one tree deep? How many of such strata would be required to build up a coal-seam, like that of South Staffordshire, thirty feet deep, seeing the great condensation of original bulk which occurs?

Mosses may grow, do grow, in peat bogs upon the dead bodies of their ancestors; but forest trees and other higher vegetation cannot. In tropical forests, the trees that fall and the leaves that are shed vanish by slow combustion and the work of microbia and insects. Their carbon is converted into gaseous carbonic acid, and only their ash remains, just mingled with a residuum of humus sufficient to form an ordinary vegetable soil, which, if burnt, would leave seventy, eighty, or ninety per cent. of ash.

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Mr. Proctor's comments on my incidental reference to phlogiston and ether seem to imply, and must convey to his readers the impression, that I accept the corpuscular theory of light. I reply, in order to defend myself against such misunderstanding, which amounts in fact to a complete inversion of my views. I regard the corpuscular hypothesis of Newton, with its fits of easy transmission or reflection, as a physical superstition one degree more gross than that of the luminiferous ether, and equally gratuitous. This may appear very rude, and, therefore, to mollify a little, I will add that my views are not original, not new, not even modern. They were quaintly enunciated by a great philosopher, who died when Sir Isaac Newton was five years old.

Torricelli says, "La materia altro non è che un vaso di Circe incantato, il quale serve per ricettacolo della forza, e dei momenti dell' impeto"—"Matter is no other than an enchanted cup of Circe, which is the receptacle of force and momentum." He continues by saying that force and momentum can be contained in no other receptacle than the intimate substance of ordinary matter. To render this a precise expression of my own views, I will translate it freely into the language of modern science, when it stands thus:—*All the activities of matter reside in the substance of matter itself, and can be manifested and communicated only by such substance.*

MODERN ANALYTICAL CHEMISTRY.*

GIGANTIC as have been the strides in theoretical chemistry since the first enunciation of the Law of Avogadro in 1811, the analytical branch of that science may, we think, fairly claim to have progressed, *pari passu*, with the hypothetical one, and to have proved itself equal to any demands which have so far ever been made upon it. Very worthily

* "Select Methods in Chemical Analysis." By Wm. Crookes, F.R.S., V.P.S.C. 2nd Edit. (London: Longmans, Green & Co. 1886.)

does Mr. Crookes sustain his reputation in the fine volume before us, to the value and excellency of which probably no more appreciable testimony could be offered than that afforded by the fact that (addressing, as it does, a comparatively limited public) it has already run into a second edition. For this is by no means an ordinary text-book, exhaustively describing the everyday work of the general analyst, but rather a laboratory companion for the advanced chemist, containing information to be sought in vain in any of the numerous works usually employed by the student. Not that the processes described in such detail are of necessity in themselves difficult; some of them, in fact, being as remarkable for their simplicity as for their elegance; but easy or operose they one and all represent the latest developments of the science of analysis, and show how it may be conducted with the greatest certainty of attaining accurate results. The various methods of separating the metal Thallium, for example, from the substances with which it is most frequently found in combination, will interest all those who remember that the description of such methods are written by the man to whom we are indebted for the original discovery of the existence of Thallium itself. Very full directions, too, are given for the separation of others of the rarer elements. Some portions of Mr. Crookes's volume may fairly be described as indispensable to all engaged in the pursuit of chemistry; such, for example, as his elaborate directions for the rigidly-correct adjustment of weights, and his admirable *résumé* of various artifices in use in the laboratory, which appear near the end of the book. As an illustration at once of elegance of method and extreme delicacy of reaction, we would instance the account of some recent modes adopted for the detection of very minute quantities of iodine, given on p. 560 *et seq.* Assuredly this is a book without which no chemical library can be considered in any sense complete.

AN ENORMOUS GRANITE SLAB.—To separate from the main ledge a slab of granite 354 feet long, three to four feet thick, and eleven feet wide, is no ordinary feat to accomplish. But this has been done at the Flynt Granite quarry, in Monson, Mass., and by the means usual in all quarries for separating slabs or blocks from the main ledge. A row of wedges were set, several hundred in number, and the workmen beginning at one end gently and carefully tapped the wedges, moving by degrees down the line, until the other end of them was reached, when the same operation was repeated. In this manner, by careful and patient application, aided by favourable conditions of the weather, the slab of the above phenomenal size was successfully separated from the main rock. The value of this immense slab, if it could have been transferred safely to one of our large cities, at not too great cost, would have been several thousand dollars. And it seemed almost sacrilegious that it was necessary to cut it up into smaller blocks for transportation—and finally used for ordinary building purposes. The possibility of getting out a slab of such size without breaking it indicates that the grain of the Monson granite not only runs evenly, but that it possesses great tenacity.

ROYAL VICTORIA HALL AND COFFEE TAVERN, WATERLOO BRIDGE-ROAD, S.E.—The Penny Science Lectures will shortly recommence at the above hall. The following are promised:—Tuesday, Feb. 2, W. P. Bloxam, Esq., on "Fire, Fuel, and Illumination." Feb. 9, J. M. Thomson, Esq., on "Dirty Water and how to Cleanse it." Feb. 16, Professor George Forbes, on "Shooting Stars and Comets." Feb. 23, Wm. Lant Carpenter, Esq. March 2, T. C. Porter, Esq., on "English Cathedrals." March 9, Dr. J. A. Fleming, on "Niagara."

THE STORY OF THE EARTH.*

GEOLOGY shares with astronomy the interest arising from the study of the life of worlds. In the star-depths we see uncounted millions of suns of many orders,—in size, in structure, and in condition,—but each probably like our own in being the centre of its family of planets. In our sun we study the one star near enough to present to us the general features of sun-life. In the solar system we see many planets, divisible into different orders, whether we consider them in regard to size and mass, or to age and condition. And lastly in our own earth we study the one planet near enough to admit of being thoroughly examined as regards its present condition, affording evidence of great interest also as to its past state, and telling us much even of its probable future. It is not only true that the study of astronomy would be as incomplete without geology as the study of the stellar universe without the fullest inquiry into solar physics, but it may be said that in the study of the earth we have the fullest and most complete evidence respecting planetary orbs, bodies which probably outnumber many times the millions of suns throughout the universe.

Thus the student of astronomy, after examining the general evidence afforded in the star-depths respecting the nature and distribution of suns (our own sun being his sample star) and inquiring further into the general evidence afforded within our solar system respecting the nature and distribution of worlds, turns to his fellow-worker, the student of geology, to tell him all that has been learned about our own world, its present condition (in air, land, water, and beneath its crust), its past history and its probable future. The position of the two studies, astronomy and geology, has thus been completely altered from what it was in past ages, when men in no sense regarded our earth as one among the bodies circling round the sun, or the sun, moon, planets, and stars, as orbs comparable with the earth in importance. Then the study of astronomy was chiefly important as throwing light on the nature of the orbs fashioned in the beginning to serve the earth, to be her light by day and her light by night, to be for signs and for seasons, and for days and years. It would have seemed inconceivable in those days that the time would ever come when the sun and moon, the stars and the planets, would in part be studied for the information which they can throw upon the present constitution, the past history, and the future fate of the earth, in those days regarded as infinitely more important than any of the heavenly bodies. It would have been equally inconceivable, also, that the earth would ever be studied for the information it could give as to the heavenly bodies, then regarded as entirely different from the earth in nature.

The study of the earth by the geologist is necessarily associated with the study of other worlds by astronomers. As Mr. Geikie remarks in the admirable work which is now before us (in a new and improved edition) "whatever is ascertainable by telescope, spectroscope, or chemical analysis, regarding the constitution of the other heavenly bodies, has a geological bearing." In particular, it is important to the geologist to inquire whether the various orbs forming our solar system (the only region where we can look for actual worlds) are all alike, in constitution and condition. If he shall find reason to think they are

* "Text-Book of Geology." By Archibald Geikie. Second Edition. (London: Macmillan & Co.)

quite unlike then he has to inquire in what respects they differ. They may be formed of very different materials, or of the same materials, or of the same materials differently proportioned; or they may be formed of similar materials similarly proportioned but in different states; or differences of all these kinds may coexist. It is unfortunate, we think, that Mr. Geikie has not sufficiently considered this general question, in the light of the most advanced modern inquiries, but has adopted the crude idea, derived in part from misapprehension of Laplace's nebular hypothesis (itself but a crude guess) in part from ignorance of the laws of physics, that the evolution of our system has led to the lighter materials finding their place in the outer planets, the heavier in those near the sun. We feel justified in saying that no astronomer now holds this opinion as even probable; while we can hardly imagine that even those who, not being astronomers, have made more or less incomplete inquiry into the matter from its chemical side, can regard the idea as more than a mere guess. Astronomically, the idea is untenable, it is opposed to the known laws of physics (for instance, the law of gaseous diffusion), while the chemist who considers the relative position of the hydrogen and the oxygen or nitrogen in our earth, will assuredly reject the idea that the lighter elements necessarily tend to the outside even in single orbs—the idea that they do so in systems of orbs formed by processes of aggregation or condensation being still wilder.

Mr. Geikie's mistake, here, is unfortunate, because it deprives him at the outset of all the light he might have derived from the consideration that there may be among the planets orbs telling of the influence of various peculiarities of structure on the progress of a planet's life-history, while there may be other orbs telling of the features characterising the various stages through which our earth itself has already passed or may have to pass hereafter. For example, we have in our moon an orb which has probably, owing to its smaller mass, had much smaller seas, much rarer air, and also much shorter life-stages than the earth; while gravity at the surface on which so much of the activity of denuding and restorative forces depends, has been but one-sixth on the moon what it has been on the earth. So that we are justified in looking on the moon for traces of the effects of those vulcanian activities which are at work in the earlier history of every planet but the effects of whose work on our own earth has long since been removed by the denuding forces of air and water. On the other hand, we are justified in expecting to find certain products of denuding action by sea, river, rain, wind, storm, ice, snow, and so forth—as mountain ranges themselves for instance—less plentiful in the moon than on the earth. Studying the moon then, we may say that because such and such features are more common on the moon than on the earth they probably belong to the earlier stages of vulcanian activity, and that because such and such features are less common on the moon than on the earth, they may probably be regarded as in the main products of denudation. Or slightly altering our point of view, the men who first studied the moon with the telescope, might had they had the general doctrine of evolution to guide them, have said that, because there are hundreds of great craters on the moon and comparatively few on the earth, therefore the more active denuding forces of the earth must have destroyed her great craters, whose wrecks however we may profitably search for; and on the other hand because mountain ranges are a much more marked feature of the earth than of the moon, the great ranges are probably the work of denudation, and we may profitably examine the structure of the Alps, the Himalayas, the Rocky Mountains, and so forth, for the evidence that, lofty though they now are, they have been formed by processes of sedimentary deposition in great trough-like depressions beneath former seas.

So with those planets which like the giants Jupiter and Saturn seem to tell us of earlier stages of planetary life. Those orbs may be profitably studied to throw light upon that past stage of the earth's history when the seas once formed a portion of her atmosphere, along with oxygen and nitrogen in many times greater amount than at present, with carbon dioxide (our former friend carbonic acid gas) in enormous quantities, with sulphurous acid, sulphuretted hydrogen, chlorine, boracic acid, sodium vapour, magnesium vapour, and other components, probably raised to enormous distances from the planet to which they were thereafter to belong by repulsive forces akin to those which act upon the vaporous material of comets' heads.* If we can recognise among the planets some which are younger than our own earth, we may be able by studying such orbs, to see our way to the recognition of our earth's state when as yet there were neither oceans nor continents.

It may perhaps be that Mr. Geikie's failure to recognise the obvious bearing of many of the most interesting astronomical researches of our time upon geological problems, has been the reason why he has left almost untouched some subjects of geological inquiry which have greatest interest for students of astronomy—as for example the history of mountain ranges as studied by some of the leading geologists in Germany and America, the question of the primeval condition of the air and sea, and the inquiry into the probable future effects of changes now in progress upon and within the earth. His study of astronomical evidence on such matters as these is limited to the inquiries—highly important no doubt in themselves—which astronomical physicists have made into the earth's own condition and probable past, inquiries in which we see astronomers dealing with geological problems rather than studying astronomical matters in such sort as to throw light on geology.

But if there is some shortcoming in this respect and Mr. Geikie has not been fortunate in his study of astronomical evidence, it may safely be said that in no other respect can any fault be found with this splendid treatise. So soon as we enter on the strictly geological matter, we find a combination of the most studious research with admirable literary qualities. The book is a student's treatise of the most thoroughgoing sort, while at the same time it is a work which every one who takes interest in the teachings of science will thoroughly enjoy. The student cannot spare one paragraph of the charmingly written passages in which the results of geological teaching are presented for general reading; and though the general reader need not be at the pains to study all the details collected for the special use of the student, yet these are so arranged that he has no trouble in knowing what to omit.

All the divisions of the work are well done; but the division relating to what Mr. Geikie calls Stratigraphical Geology, the record of the earth's crust (that great volume of Nature's Bible) as to material life and as to the varied forms of vegetable and animal life which have successively prevailed on the earth, is especially valuable. Complete (so far as on the scale even of so large a book

* In some such way only can the apparent inconsistency between the observed depths of the gaseous and vaporous envelopes of the giant planets (or of the sun) and the laws associating density and pressure of gases and vapours, be removed or explained.

as this such a record can be complete) for the most conscientious student, it has all the interest of a grand romance for the reader who not being a student of geology takes thoughtful interest (as every cultured person must) in the results of scientific research.

We shall return, and more than once, to the subjects dealt with in the various divisions of this work. In the meantime we commend it warmly to those among our readers who have not yet seen it. Those who have will need no recommendation. The new edition has been much enlarged, and carefully brought up to date in regard to geological and palæontographical matters. The book might well bear the title which heads this paper. When shall we have a "Story of the Heavens" as well done?

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

COLOUR AND LIGHT.

NOW, before proceeding any further, we must stop to caution the student that the theory of three primary colours expounded in our last chapter is, and can be, only what the metaphysicians call "subjectively" true: in other words, it is only so as regards *our own sensations*. A very little thought will suffice to show that, externally to ourselves, there can be no such thing as three elementary kinds of coloured light; for, from what has preceded, it must be obvious that many hundreds of different tints are existent in the spectrum—each with its appropriate wave-length—to say nothing of the waves at both ends of it, which fail to affect our vision at all. Once more, then, light consists of nothing but a series of undulations or vibrations, the length and frequency of which, when they impinge on the retina, affect us with the various sensations of colour. We know that when the rays of the sun fall upon the nerves of sight we are affected with the sensation of light; whereas the identically same rays, exciting our nerves of touch, produce in us the sensation of heat. And so in Young's theory, all that is postulated is that the difference of our sensations of colour has its origin in the *kinds* of nervous fibres which are excited. When all three kinds are equally stimulated we see what we call white light. Colour, in the sense in which we know it, can have no existence whatever outside of ourselves; though the actual waves in the æther of every conceivable length, of course, both can and do exist. With this qualification, then, we will resume the thread of our description.

We said on page 96 that red and greenish blue, orange and a greenish blue, bright blue and bright yellow, and greenish yellow and violet light, when mixed in the indicated pairs, all four give white light as a result. It will, then, only seem natural that if, by any means, we subtract one of these colours from white light, the other, its so-called "complementary" colour, will remain; and this we shall find to be the result of direct experiment. Now, an accurate knowledge of what these complementary colours severally are is of the greatest practical importance to the artist, since, as we shall find, they afford the very strongest contrasts that it is possible to obtain, when placed in juxtaposition. One of the most simple methods of obtaining truly complementary colours is by the aid of the polariscope and thin films of selenite. Another way, by a system of trial and error, is to employ the double-image prism shown in Fig. 8 (p. 96), at P. Placing a parallelogram of paper coloured of the tint whose complement we wish to obtain on a dead-black ground, we paint a similar piece of what we suppose should be the complementary colour; and, laying it by the side of our first piece, cause their duplicated images to overlap by regarding them through our prism. If the resulting image be not white (or rather, using coloured paper pure grey), we see what colour predominates, and suppress this if it leaves our first tint outstanding, and *vice-versa*, until we hit upon a shade which exactly neutralises our first one. Or, preferably, we use Maxwell's discs (Fig. 6, p. 95), because from their construction they enable us to add more than one colour to our compensating sector, and so ultimately to obtain a mixture that shall, with our original one, accurately make up white—or, as we have said above, pure grey—light. Suppose, for example, that we wish to find the complement of the crimson of the spectrum, we shall discover that neither blue nor bright green will serve our purpose, but if we add a green sector of the proper size to our blue one, we shall find that the two in combination will neutralise our crimson, and produce white light (or its equivalent, in our apparatus, pure grey). In the same way a purple truly complementary to green may be arrived at, and so on. Or, finally, there is the rough-and-ready method hinted at at the conclusion of our last paper—that of tiring the retinal nerves out by gazing intently at any given colour, and then turning the eye towards a white surface; from which the temporarily colour-blind retina will select the colour to which it is fresh. Almost every one, we suppose, has tried this experiment in the form of staring at a red wafer on a white sheet of note-paper, and suddenly removing the wafer, when the spot it occupied on the paper will appear as a green one. The explanation of this, after what has preceded, must be obvious. The spot on the retina on which the image of the wafer has fallen has become tired out as far as red light is concerned; and when the exciting red image is suddenly withdrawn and the spot it occupied is filled with white light, the fatigued nerve fails to detect the red element in the white light, but picks up the green one readily enough. In a similar fashion if we steadily regard a well-lighted brightly-coloured picture for some time and then turn the eyes rapidly towards the ceiling we shall see its "after-image" in complementary colours. A striking way of showing the existence of retinal fatigue is to put a sheet of note-paper on a dark background and cover half of it with a piece of dead-black card, fixing the eye steadily upon a point about the middle of the boundary of light and darkness. The paper should be well lighted. After gazing at this arrangement for a minute or two, if the black card be suddenly removed, that half of the paper which is previously covered will seem very notably brighter than the other one which has been continuously under observation.

We have now seen how the sensation of white light is produced by the excitation of all three of the retinal elements whose vibrations produce in our brain the sensations of red, green, and bluish-violet, or violet-blue; and further, how a very considerable range of the multitudinous colours observed in nature is producible by the mixture of these primary colours in various proportions. Considerable however as this range of colours is, it is very far indeed from exhausting all the tints and hues we behold around us, which, at first sight, it seemingly should do, were the colours we have specified really ultimate ones. But, so far, we have proceeded on the assumption that their action on the eye never varies,

XUM

and that as long as we can see them at all, their distinctive tint remains invariable. A very little reflection will suffice to show that this is not the case. Take, as an illustration, a soldier's coat (let us say an officer's, inasmuch as "Tommy Atkins's" tunic is not always of the very brightest or best dyed cloth). If we regard this in brilliant sunshine it will look quite orange-coloured, as compared with its scarlet tint as seen by the light of an ordinary white cloud; while, as evening draws on, the red gets darker and darker, until it becomes almost indistinguishable. It is noteworthy that the intense red of carmine is much less affected by darkness. Green, when in the full glare of sunlight, becomes a yellowish green, and even a kind of pale yellow. Violet, in the same way, becomes blue and even blue-grey; darkening, as in the case of red, as the illumination is decreased; but, unlike red, continuing to show as violet as long as any light falls on it at all. All this may be prettily shown by making a little bouquet of scarlet geraniums, pansy ("Purple King" answers well), and any bright green leaves, and studying the seeming change in the tints of its components by viewing them first in brilliant sunshine, then in ordinary daylight, and finally in a darkened room. From all this we shall gather that we have not only our three primary colours in their normal state to deal with in forming compound ones, but that we have an indefinitely large series producible by mixing white light with them, as also by altering their luminosity. This may be well illustrated by using our Maxwell's discs, employing a plain white one to mix white light with the colour to be tested, and a dead-black one to degrade its luminosity. Suppose, for example, that we take a disc painted with chrome yellow. If we combine this with a white one, on rotating the combination rapidly on our whirling table, it will be seen to exhibit a decidedly orange hue. If now we exchange our white disc for a black one, we shall find the resulting colour will be an olive-green. This is very striking, and cannot fail to impress the student with the large range of tints producible by mere change in luminosity. He is strongly urged to prepare a series of discs as purely and brilliantly-coloured as he can produce them, and try for himself the results of their combinations with the simple black and white ones.

Now, it might reasonably be supposed that if any given colour changes so manifestly under varying illumination, the difficulty of judging of it would be well-nigh insuperable. In practice, however, as Helmholtz points out, we find that we are able to judge of local colour without either uncertainty or hesitation, under the most diverse conditions. Thus, white paper in full moonlight is darker than black satin in daylight, but we never have the smallest difficulty in recognising that the paper is really white and the satin black; though, at the same time, a brilliantly-illuminated grey surface may appear identical in colour with a white one in shade. By throwing a strong beam of light (by the aid of a lens) on to a grey disc whose diameter is the same as that of the beam, the disc will appear perfectly white. This is most strikingly shown by mounting the circle of grey paper on a sheet of white cardboard illuminated by diffused light. A notable result of the diminution of the intensity of light is to practically reduce the spectrum to the three colours red, green and violet. If the light be still further diminished, the violet disappears, the red turns to a kind of chocolate colour, and the green is seen as a pale green. Finally if we continue to reduce the light passing through our prism, the chocolate colour vanishes, and the green alone remains, itself to turn to a sort of grey before the ultimate extinction of the light altogether. We are indebted to Von Bezold for this curious experiment. Here we get a glimpse of the origin of such colours as brown, which, of course, have no existence in the ordinary spectrum; and we may further illustrate their production by attaching not a whole Maxwell's disc to the axis of our whirling table, but a simple card sector painted with vermilion, and placing a sheet of dead-black paper behind it as a background, prior to setting the sector in rapid rotation. The effect of this arrangement on the eye is that of a circle of rich chocolate-brown colour.

We have seen, then, that the juxtaposition of complementary colours sensibly heightens and intensifies them; and that any considerable increase or decrease in their illumination also causes the most marked apparent changes in their hues. We may now say a few words as to the practical application of the principles we have been endeavouring to explain. To the artist the knowledge of these principles is, of course, simply indispensable. If, then, we wish in, say, a water-colour sketch to make any given colour "tell" to the utmost, we must contrive to oppose its complementary colour to it. Let the reader get a sheet of blue and a sheet of yellow paper, and out of the latter cut two squares or discs. Now, let one of these be laid upon the sheet whence it was cut, and the other on the blue sheet, and regarded side by side. It will not be easy at first for the observer to persuade himself that they are identical in colour, so much more brilliant will the disc appear which is superposed on the blue sheet. Or, again, he may perform a modification of the experiment of Helmholtz, described on p. 97, and providing himself with a sheet of red paper, place upon it a disc of bluish green, and regard the latter steadily for a minute or so. If, now, an assistant will suddenly blow it away, the space which it occupied will appear of a decidedly more intense red than the rest of the sheet, for a reason with which the student is by this time familiar. In Barnard's "Landscape Painting in Water Colours" will be found a series of diagrams of a grey pattern on variously-coloured backgrounds which are very instructive. Or better still, we may go direct to nature herself, and notice the glorious contrast of an orange-red sunset with the vivid purple of distant hills behind which the sun is descending; the distinctly green tint of the moon as seen against one of the lovely rosy-"afterglows" which have prevailed in various parts of the world since the beginning of 1883, and so on. Moreover, as we have seen how much paler colours become when very brilliantly illuminated, green, for example, looking almost yellow in the glare of the sun, we hence get a hint as to the most natural method of painting any brilliantly-illuminated landscape, *i.e.*, to impart a yellow tone to the bright lights. The careful observer of nature, too, will note how the prevailing colour of the source of illumination of a landscape affects those of the shadows cast by the various objects in it. And, in connection with the colours of shadows, by the way, a very curious and instructive experiment may be made without much difficulty by any one who can command the use of a room with a single window, closed by a shutter in which a small aperture has been perforated. Through such aperture we admit the daylight reflected from a bright white cloud, and setting up a rod (a broom-stick will do) in the middle of the room, in the path of the rays; its shadow must be made to fall upon the opposite wall of the room, if white; or, in default of this,

on a tightly-stretched white sheet, or large sheet of cardboard. Under these circumstances it will appear grey. Now, though, let us light a candle. This will also illuminate our white background, of course, with a yellowish light, and will cast a second shadow of our rod, which should be made to fall a short distance either to the right or left of our shadow number one. Care should further be taken by varying, if necessary, the size of the hole through which the daylight comes, to render the shadows equal in intensity. Under these circumstances, the rod cutting off the light of the candle from that part of the wall or screen upon which its shadow falls (and which is thus illuminated by daylight alone) should, theoretically, leave it white; but, owing to the effect of contrast, it will appear quite perceptibly blue; what we may call the daylight shadow of the rod seeming to be of a yellowish colour, as might be expected from the fact that it is illuminated by the yellow candle-flame. A very remarkable addition to this experiment was devised by Helmholtz, who viewed the inner edges of the two shadows—and, of course, the intermediate strip of the illuminated field—through a tube blackened internally, and gazed at them until the second shadow exhibited its most pronounced blue tint. Then he moved the tube until this shadow filled the field of view, when, curious to relate, although the yellow field, to the original contrast with which the seemingly blue colour was due, had now disappeared, the opening of the tube still seemed to be filled with bluish light. Nay, what appears still more surprising, upon blowing the candle out, the impression of blueness remained, albeit it vanished at once on removing the tube and looking straight at the screen. Here, evidently, the illusion must be in our own judgment, irrespectively altogether of any specific action on the nervous fibrillæ of the retina. Variations of this curious and really startling effect may be made by having two holes in the shutter with which we darken the room, and covering them with differently-coloured glasses or sheets of coloured gelatine. Another experiment, made with even less trouble than the one just described, was contrived by Mayer, who upon a sheet of bright green paper placed a small rectangle of grey paper. Gazing at this the green will look green and the grey grey, the effect of contrast being almost imperceptible. If, though, we cover the whole arrangement with a thin piece of tissue-paper, the green is notably diluted and weakened, and our grey slip of paper at once puts on a distinctly reddish hue. From this we derive a rule of considerable value to the artist—viz, that pale tints in juxtaposition exhibit the effect of contrast much more vividly than absolutely pure, strong ones do. Furthermore, it will be found that if we place in contact two rectangles of paper coloured identically save that one is pale and the other deep in tint, the pale slip will look paler, and the darker slip darker than when they are viewed apart. The best way to show this is to cut two such pieces out of each sheet; lay one from each piece together, and the remaining two, at some distance apart, upon a table, and look at them. The effect of proximity in seemingly altering their hues will strike the eye at once. Finally, the result produced by the mere contiguity of differently-shaded surfaces may be instructively shown by colouring a series of cards with absolutely flat washes of Indian-ink or lamp-black, each one darker than its predecessor. Laying these one over another, they almost suggest the idea of a fluted column, so much darker do the light ones appear where they are in contact with lighter ones still, and *vice-versâ*. This effect is seen on a grand scale in North Wales and other mountainous countries, where the landscape so often contains range after range of mountains up to the horizon. The slightest attention will show that the lower parts of any one of these ranges invariably seems lighter than the upper part of that immediately in front of it; and it must be always so represented in a sketch, if an accurate reproduction of the natural effect is aimed at. In fact, it will be observed that the sharp dark edge of any visible object lightens, quite notably, that part of a more distant one immediately behind it. The effects of contrast further produced by the superposition of colours upon black, white, and grey backgrounds, or by contact with masses of them, will be best learned from a series of experiments by the student himself. A very little thought will enable him to apply the principles we have been endeavouring to make clear, to the explanation of the phenomena which he will observe.

NOTES ON EARTHQUAKES.

By Richard A. Proctor.

THE EARTHQUAKE OF CALABRIA.

O earthquake has ever happened, the circumstances attending which have been so carefully noted as in the case of the earthquake of Calabria in 1783. This celebrated earthquake began in February, 1783, and lasted until the end of 1786. The first shock threw down, "in two minutes, nearly every house in all the cities, towns, and villages, from the western flanks of the Apennines in Calabria Ultra to Messina in Sicily, and convulsed the whole country." The second took place seven weeks later, and was scarcely less violent. Sir Charles Lyell mentions that "the great granite chain which passes through Calabria from north to south, and attains the height of many thousand feet, was shaken but slightly by the first shock, but rudely by those which followed."

The manner in which a large extent of country was permanently affected by this earthquake is very well worth noticing, as affording an excellent illustration of the mode in which earth-waves travel.

The Apennines are formed for the most part of massive and hard granite, with steep inclines, upon the base of which lie those strata of sand and clay which form the Calabrian plains. These plains are usually level, but are intersected in places by narrow valleys and ravines whose sides are almost vertical. The effect of the earthquake was to *shake down* those parts of the Calabrian plains which border on the granite backbone forming the Apennine range. The soil "slid over the solid and inclined nucleus, and descended somewhat lower," says Lyell, "leaving almost uninterruptedly from St. George to beyond St. Christina—a distance of from nine to ten miles—a chasm between the solid granite nucleus and the sandy soil. Many lands slipping thus were carried to a considerable distance from their former position, so as entirely to cover others; and disputes arose as to whom the property which had thus shifted its place should belong to."

The whole of the country over which the effects of the great shocks extended was at times heaved simultaneously, like an angry sea, and sensations resembling sea-sickness were experienced by many of the inhabitants. Those who have watched the sky from the deck of a sea-tossed ship will have noticed that the drifting clouds seem at times to be arrested in their motion; it is in reality the ship which is moving for the moment in the

same direction as the clouds, and thus neutralises the effects of their motion. The same phenomenon was observed during the Calabrian earthquake; and nothing serves to give us a stronger impression of the turbulence of those internal heavings which make the dry land as unstable as the billows of a swelling sea. Trees whose roots continued firmly embedded in the soil were seen to lash the ground with their branches.

It will be evident that the seat of disturbance was beneath the rocky ribs of the Apennines. The superincumbent soil was swayed with violence by the vibrating mountain-slopes. But the chief mischief followed when the vibration ceased. For then the soil to which motion had been communicated began to slide over the now stationary granite, and this sliding motion being quickly checked by the irregularities of the rocky substratum, there resulted a destructive shock to all objects—houses, trees, or living creatures—upon the shaken plains. One may illustrate the nature of the shock as follows:—Suppose a small table-cloth to be lying on a large table with raised edges, and that a variety of objects stand upon the cloth. Then, if the table be shaken with a gradually increasing violence, these objects may continue in safety, provided the motion is so managed that there is no abrupt change of direction, and no sudden increase or diminution of velocity. If the motion of the table be suddenly checked, the cloth would not immediately lose its motion, but would slide till it was stopped by the raised edge of the table; and objects on the cloth would move with it, until its motion was checked, when they would receive a shock more likely to be destructive than any which had been communicated to them while the motion of the table continued. And just as such a cloth would "rumple up," as soon as the motion of one end was checked, so the soil of the Calabrian plains was found to be in some parts abnormally raised, in others as strangely depressed. "In the town of Terranuova," says Sir Charles Lyell, "some houses were seen uplifted above the common level, and others adjoining sunk down into the earth. In several streets the soil appeared thrust up, and abutted against the walls of houses; a large circular tower of solid masonry, part of which withstood the general destruction, was divided by a circular rent, and one side was upraised, and the foundations heaved out of the ground."

As might be expected, the soil did not continue unbroken by the violent shocks to which it was subjected. In the central parts of the disturbed region, the earth opened so widely as to swallow up large houses. In Cannamaria many buildings were "completely engulphed in one chasm," insomuch that not a trace of them was ever seen afterwards. So violently did these chasms close their yawning jaws, that afterwards, when excavations were made for the recovery of valuables, the workmen found the contents of houses crushed into a compact mass with detached portions of masonry. In some instances persons were engulphed by one shock and thrown out again alive by the following one.

The magnitude of some of the fissures which were formed during this earthquake affords startling indications of the tremendous violence of the earth's internal throes. Grimaldi observed in the territory of San Fili a newly-formed ravine half-a-mile long and twenty-five feet deep, and another of similar dimensions in Rosarno. In the district of Plaisano three enormous fissures were formed: one a quarter-of-a-mile long, about thirty feet in width, and 225 feet deep; the second, three-quarters-of-a-mile long, 150 feet broad, and 100 feet deep; and the third, *nearly a mile long*, 105 feet broad, and thirty feet deep.

If any evidence were required as to the true nature of the disturbance, it would be found in the remarkable motions of masses slightly attached to the surface-soil. Paving-stones were flung into the air, and masses of loose soil flung in showers over the surrounding objects.

In this earthquake 40,000 persons are supposed to have perished, and about 20,000 by the epidemics which followed. Dolomieu gives a painful account of the appearance of the Calabrian cities. "When I passed over to Calabria," he writes, "and first beheld Polistena, the scene of horror almost deprived me of my faculties; my mind was filled with mingled horror and compassion; nothing had escaped; all was levelled with the dust; not a single house or piece of wall remained; on all sides were heaps of stone so destitute of form that they afforded no idea of there having ever been a town on this spot. The stench of the dead bodies still arose from the ruins. I conversed with many persons who had been buried for three, four, or even five days; I questioned them respecting their sensations in so dreadful a situation, and they agreed that, of all the physical evils they endured, thirst was the most intolerable; and that their mental agony was increased by the idea that they were abandoned by their friends, who might have rendered them assistance."

The destruction of the Prince of Scilla and a great number of his vassals, was one of the most remarkable events attending this deplorable catastrophe. He had persuaded his servants to seek their fishing-boats for safety, and went with them to encourage them. During the night of Feb. 5, while they were sleeping, an enormous mass of earth was flung from Mount Jaci upon the plain near which the boats were moored. Immediately the sea rose more than twenty feet above the level of the plain. Every boat was sunk or dashed upon the beach, and hundreds of persons who had been sleeping on the plain were swept out to sea. The Prince and 1,430 of his servants perished.

EARTHQUAKE AT RIOBAMBA.

One of the most remarkable earthquakes ever experienced was that which overthrew Riobamba on Feb. 4, 1797. A district 120 miles long and 60 broad was shaken by an undulatory motion which lasted for four minutes, and a far wider district felt the effects of the disturbance. Within the space first named, in which the movement was more energetic, every town and village was levelled to the ground; and many places were buried under large masses flung down from the surrounding mountains. Among these was the flourishing town of Riobamba. Preceded and accompanied by no warning noises whatever, the terrific concussion in a few moments effected the complete desolation of the unhappy district. The earthquake was a singular combination of perpendicular, horizontal, and rotary vibrations. So violent was the perpendicular, or as it may be termed the explosive movement, that hundreds of the wretched inhabitants were flung upon the hill La Culla, several hundred feet high, on the further side of the small river Lican. Then came a horizontal movement, so rapidly succeeding the other that in many instances the furniture of one house was found beneath the ruins of another. In some cases property was removed so far from its original place, that disputes arose among the survivors of the catastrophe, and the Audiencia, or Court of Justice, was for some time occupied in adjusting these difficulties. Not less remarkable were the effects of

circular or rotary concussions. Walls beyond the town were twisted round without being flung down; rows of trees which had been parallel were deflected in the most remarkable manner; and the direction of the ridges of fields covered with various kinds of grain was observed to be altered by the effects of the earthquake.

Humboldt, it may be mentioned, explains in a somewhat unnatural manner the peculiar effects we have spoken of above. He conceives that the fact of the furniture of one house being found under the ruins of another, seems to show that the movement was first directed downwards, then horizontally, and then upwards. This appears to me wholly improbable. In the first place it has been almost constantly observed that the upward motion (in earthquakes which exhibit perpendicular vibrations) precedes the downward; and secondly, had the downward motion taken place first, it seems most probable that neighbouring houses would have sunk *side by side*, so that the following horizontal movement would only have resulted in the forms of destruction ordinarily observed in earthquakes. The more natural view seems to be that there was first a violent upward movement, flinging the less firmly built houses bodily upwards, and merely destroying others; then immediately followed a downward movement and a horizontal one, bringing the latter class of houses beneath the falling ruins of the others. Or it may be that so violent was the first upward movement, that the upper parts of all buildings were flung into the air, whence—not partaking in the horizontal movement which displaced the foundations and lower part of the houses—they fell in ruins over the *débris* of buildings they had not belonged to originally. An upward, followed by a downward, and then by a horizontal movement, might result in either form of demolition, or in both.

A short time after the destruction of Riobamba, a fearful subterranean rumbling, resembling the loudest thunder-peals, was heard under the cities of Quito and Ibarra, the former more than a hundred miles from Riobamba.

EARTHQUAKE NOISES.

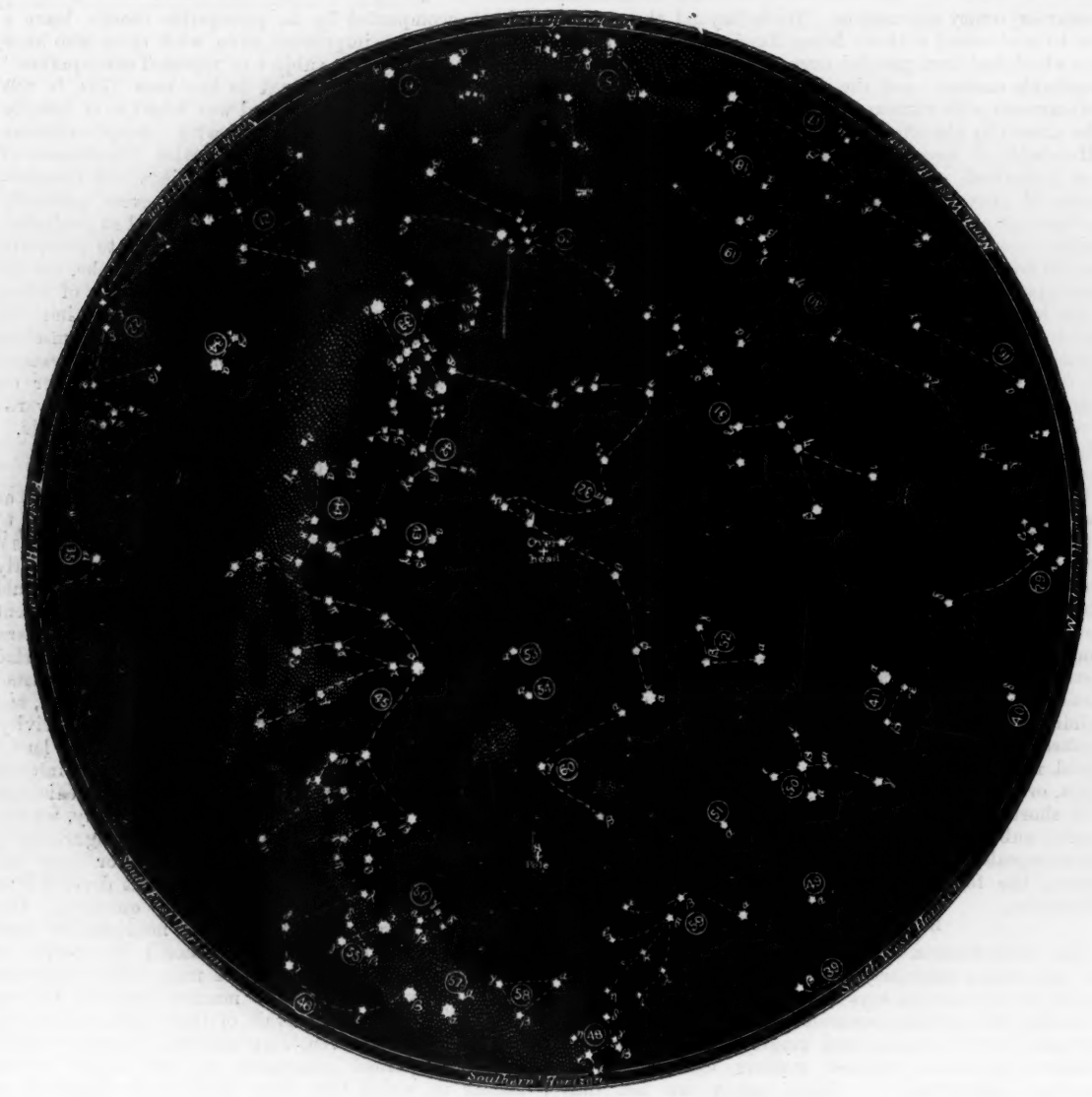
The subterranean noises heard during earthquakes are sometimes singularly striking. The nature of the noises is very various, says Humboldt, "rolling, rattling, clanking like chains, occasionally like thunder close at hand; or it is clear and ringing, as if masses of obsidian or other vitrified matters were struck in caverns underground." These noises are not only heard much farther off than they could be if they were transmitted in the air, but they travel much more rapidly. In 1744, when the great eruption of Cotopaxi took place, subterranean noises were heard at Honda, on the Rio Maddalena. The crater of Cotopaxi, 17,000 feet above the level of Quito, is separated from it "by the colossal mountain-masses of Quito, Pasto, and Papayan, by innumerable valleys and precipices, and by an actual distance of no less than 500 geographical miles." The eruption which took place in the island of St. Vincent on April 30, 1812, produced subterranean noises resembling the loudest peals of thunder in Caraccas, in the plains of Calabozo, and on the banks of the Rio Apure, a distance of upwards of 700 geographical miles. "This, in respect of distance," says Humboldt, "was as if an eruption of Mount Vesuvius were to be heard in the north of France."

But it is remarkable that subterranean rumblings and bellowings are sometimes heard when neither an earthquake nor the kindred phenomenon—a volcano—is in progress. "Sonorous phenomena," Humboldt tells us, "when accompanied by no perceptible shocks, leave a remarkably deep impression even with those who have long dwelt in districts subject to repeated earthquakes." A singular instance occurred in the year 1784, in the high lands of Mexico. A sound was heard as of heavily rumbling thunder alternating with sharp explosive bursts beneath the feet of the startled inhabitants of Guanaxato. The subterranean bellowings and thunderings (*bramidos y truenos subterraneos*) grew gradually more and more intense, and then decreased as gradually. Terrified by a phenomenon which seemed to forewarn them of an approaching and terrible catastrophe, the inhabitants fled from the town, leaving great piles of silver bars a prey to bands of robbers. But after a time the more courageous returned and repossessed themselves of their treasure. For one month the subterranean grumblings were heard at intervals, though neither on the surface of the earth, nor in the silver mines 500 yards beneath it, was any movement of the earth perceptible.

THE EARTHQUAKE AS A RESTORING POWER.

We are so in the habit of regarding the earthquake as an agent of destruction, that it may sound paradoxical to assert that the phenomenon is surpassed by no other as a regenerative and restorative agent. Yet this is strictly the case. But for earthquakes our continents would continually — however slowly — diminish in extent through the action of the sea-waves upon their borders, and of rain and rivers on their interior surfaces. "Had the primeval world been constructed as it now exists," says Sir John Herschel, "time enough has elapsed, and force enough, directed to that end, has been in activity, to have long ago destroyed every vestige of land." It is to the reproductive energy of the earth's internal forces that we are alone indebted for the very existence of dry land. To the same cause, undoubtedly, we owe that gradual process of change in the configuration of continents and oceans which has been for ages and still is in progress—a process the benefit derived from which cannot possibly be called in question. Our forests and our fields derive their nourishment from soils prepared, for long ages, beneath the waves of ocean; our stores of coal and of many other important minerals have been in like manner prepared for our use during the long intervals of their submergence; we build our houses, even, with materials many of which owe their perfect adaptation to our wants to the manner in which they have been slowly deposited on what was once the bed of ocean, and compressed to a due solidity and firmness of texture beneath its depths. If it is indeed true, as Humboldt asserts, that "the destiny of man is in part dependent on the fashion of the outer crust of the globe, on the partitioning of continents, on the direction of the mountain chains which traverse them, and on the distribution of land and water," then we must look upon the earthquake as the most important of all those agencies which tend to the renovation of our terrestrial globe. So far from dreading lest the earth's subterranean forces should acquire new energies, we ought rather to fear lest they should lose their force. We may, therefore, gladly hail the opinion of the great geologist who asserts that "the energy of subterranean movements has always been uniform as regards the *whole* earth. The force of earthquakes," adds Lyell, "may for a cycle of years have been invariably confined, as it is now, to large but determinate spaces; gradually, however, this force shifts in position, so that other regions, for ages at rest, become "in their turn the grand theatre of action."

XUM



1. THE NIGHT SKIES IN AUSTRALASIA:—
At 9 o'clock January 7; at 8.30 o'clock January 14; at 8 o'clock January 22.

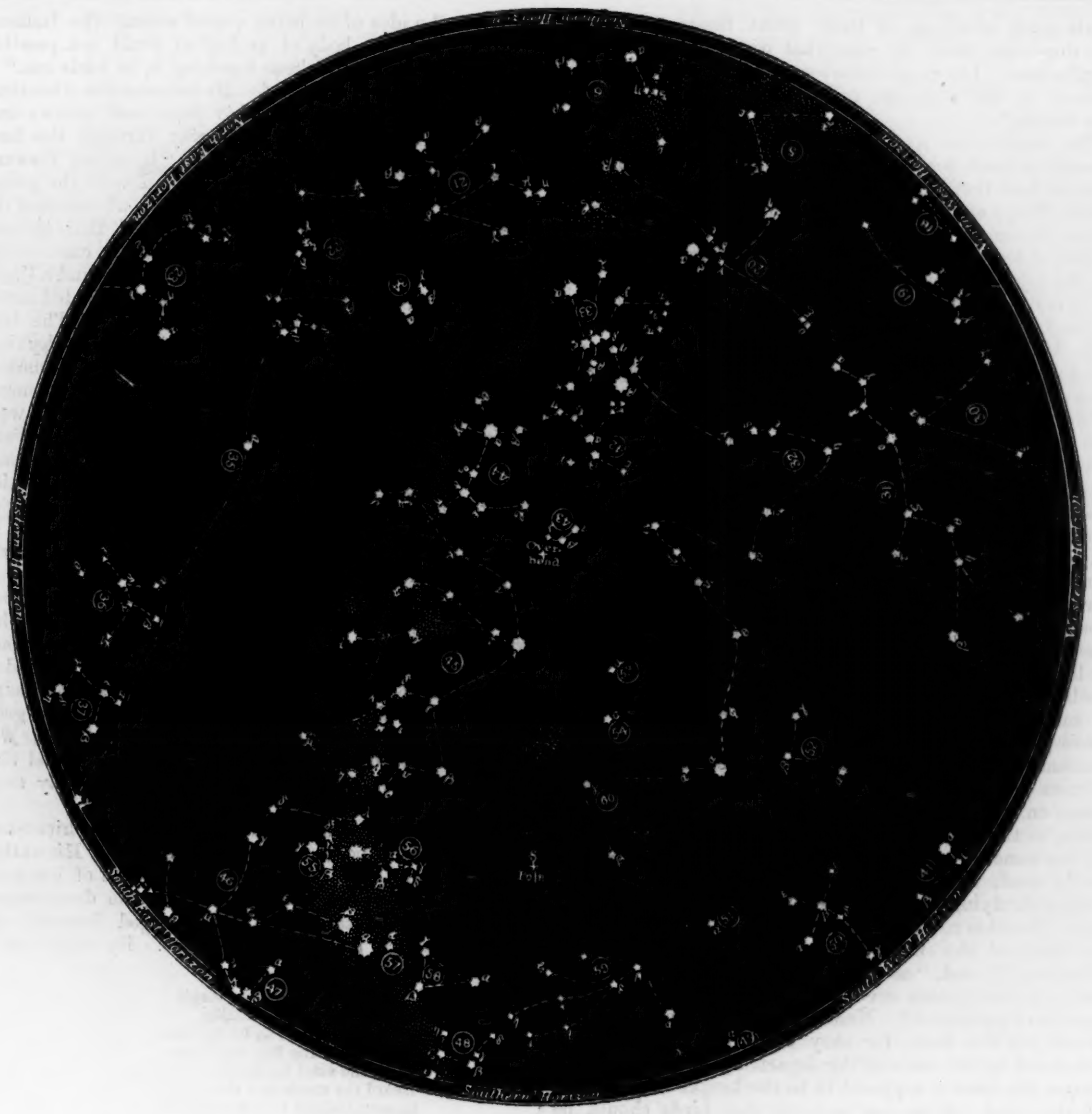
THE NIGHT SKIES IN AUSTRALASIA, CAPE COLONY, ETC.

By Richard A. Proctor.

I REPEAT this month the map showing the southern skies, in January, for places between south latitude 30° and 45°; but the map is this month much simplified. I add the map for February in the same simple form. The Constellations are numbered as in my "Star Primer" up to 46 (*Centaurus*). The remaining numbers indicate the Constellations nearer the south pole, viz.:—

47. *Lupus*, the Wolf.
48. *Ara*, the Altar.
49. *Indus*, the Indian.
50. *Grus*, the Crane.
51. *Toucan*, the Toucan.
52. *Phœnix*, the Phœnix.
53. *Dorado*, the Sword-Fish.
54. *Reticulum*, the Net.
55. *Crux*, the (Southern) Cross.
57. *Circinus*, the Compass.
58. *Triangulum*, the (Southern) Triangle.
59. *Pavo*, the Peacock.
60. *Hydrus*, the Water Serpent.

The student may find it interesting to compare the alternate maps of my "Star Primer" (where twenty-four maps are given, instead of twelve maps, as in the southern series, and my "Half-hours with the Stars") with those now appearing here, which are on the same plan and scale. He will find that the stars showing low down



2. THE NIGHT SKIES IN AUSTRALASIA:—
At 9 o'clock February 6; at 8.30 o'clock February 14; and at 8 o'clock February 21.

towards the south in northern skies at any given hour, are almost exactly overhead in the latitude for which the present maps are drawn. (For this, and for the circumstance that the southern stars circle around a polar point precisely as the northern stars do, the southern skies should make their apologies to Mr. Hampden.)

INDIAN MYTHS.

By "STELLA OCCIDENS."

OME of the North American Indian tribes "allowed themselves the alternative of supposing a dream to be either a visit from the soul of the person or object dreamt of, or a sight seen by the rational soul, gone out for an excursion while the sensitive soul remains in the body."* And others believe that the dreamer's soul leaves his body, wandering in quest of things attractive to it. "These things the waking man must endeavour to obtain, lest his soul be troubled and quit the body altogether."†

During sleep the body apparently remains lifeless and dead, although on awaking the Indian, and all men alike, can distinctly remember events which they dreamt of, and which to the ignorant mind appear as realities. "So strong was the North American's faith in dreams, that on one occasion an Indian dreamt he was taken captive. He induced his friends to make a mock attack on him, to bind and treat him as a captive, and actually submitted to a considerable amount of torture in the hope thus to fulfil his dream."‡

As savages are anything but temperate in their habits,

* Tylor's "Prim. Culture," vol. i., p. 443. † *Ibid.*, 440.
‡ "Origin of Civilisation." Sir J. Lubbock, p. 207.

their sleep after one of their great feasts (especially the dog-feast) must be somewhat disturbed by horrible nightmares. On these occasions sorcerers, and all the friends of the man, are called around to account for the dream.*

No doubt this was done with regard to the myth already related, for we see that the chief really believed that he had travelled along the "Path of spirits" (the Milky Way) and had entered the happy hunting-ground of the Indian—viz., the sun. They believe that it is the "land of happy souls, the realm of the blessed, the scene of the joyous hunting-grounds of the hereafter."†

It is interesting to trace the chief's path, and see how it can be explained. The chief at first describes the path (the Milky Way) as leading him through a shady grove (the shades of night). The elevated ridge is the dusky line or bank of clouds above the northern horizon, from which the first rays of the *Aurora borealis* (the old man) are seen. The old man is described as having white hair, eyes of fiery brightness, and around his shoulders a robe of skins. The streams of auroral light, which sometimes assume a wavy appearance, suggest the idea of the old man's hair, the flashing of the aurora corresponds with the brightness of his eyes, and the robe of skins represents the auroral glare.‡ The old man bids the chief rest awhile, and gives him the following directions. "See yonder gulf (the twilight between Night and Day) and the wide-stretching blue plains beyond (the blue Sky). It leads to the land of souls (the Sun). You stand upon its borders (first dawn of light), and my lodge is the gate of entrance. But you cannot take your body along." This corresponds with the belief among the North American Indians that the souls of the departed either assume the form of stars or birds. They know that when any one dreams of going on a long journey, the body remains in the same place, so they imagine it must be their soul that travels. In the same way at death they suppose that the body is really dead, but the soul assumes the appearance of a bird, and, flying upwards, disappears apparently in the sky. For this reason birds are classed among the deities, in some of the tribes, such as the Creeks and the Natchez;" § and, "as the associate of the god of light and air, the Aztecs reverence a bird called *quetzal*, a species of parroquet." Neither the Hurons nor Mandans would kill the dove, for they believe that doves were inhabited by the souls of the departed.‖ By some other tribes, the dove is supposed to be the keeper of the souls of the dead. It is very natural that birds should be considered inhabitants of another world.¶ As they fly upwards they appear to vanish in the sky; they wander about freely; they are always singing, showing the happiness of the blessed spirits, and their plumage (which is especially gorgeous among some of the American birds) is a fit apparel for the inhabitants of the regions of the sun. The fact of a bird flying over water confirms the idea of its being a soul among the Indians, for they know the body of an Indian could not possibly pass over the water without touching it, as birds can.*

But to return to our chief. He followed the directions of Chibiabos, and leaving his bow and arrows and dog behind him, was soon on his way through the land of "Shadows." He is described as "bounding forward as if his feet had suddenly been endowed with the power of wings."† Possibly he, or rather his soul, assumed the form of a bird, especially as we are told that he met many beautiful birds on his way. At last he came to the banks of a lake (the blue sky), and here he found a snow-white canoe (or white cloud), and on this he floated across the lake, meeting his fair bride on the way. The lake was covered with foam (in other words, the sky was covered with stormy-looking clouds), and the turbulent waves threatened to swallow them up each moment. Some boats (white clouds) were swamped and many were drowned (that is, lost in the larger clouds).‡ The canoes in which little children travelled met no waves and passed over in safety (the children floated on small clouds, which being lighter floated higher in the air, and escaped collision with the bank of heavy clouds below).

At last the chieftain and his bride reached the happy hunting-grounds, and here they wandered, free and happy, among beautiful flowers and meadows. However, their joy was soon ended, for the voice of a spirit wafted on the breeze bade the chief return to earth, and the spirit giving a few directions, the soul returned to the sleeping chief. He awoke from his dream, and carefully related all he had seen and heard, to the great edification, no doubt, of the assembled listeners, who possibly believed that their chief had paid a special visit to the home of the Great Spirit, and had really experienced all he related.

Longfellow introduced this myth of the "White Stone Canoe" into his poem, Hiawatha, in Part xv. "Hiawatha's Lamentation." He is lamenting the death of his great friend Chibiabos, who whilst hunting the deer crossed the Big Sea-Water, and was dragged beneath the treacherous ice by the Evil Spirits. By magic he is summoned thence:

"And so mighty was the magic
Of that cry and invocation,
That he heard it, as he lay there,
Underneath the Big Sea-Water;
From the sand he rose and listened,
Heard the music and the singing,
Came, obedient to the summons,
To the doorway of the wigwam;
But to enter they forbade him;
Through a chink a coal they gave him,
Through the door a burning fire-brand;
Ruler in the Land of Spirits,
Ruler o'er the dead they made him,
Telling him a fire to kindle
For all those who died thereafter—
Camp-fires for their night-encampments,
On their solitary journey
To the kingdom of Ponemah—
To the land of the Hereafter.§

* A whole tribe of Australians have been known to decamp because one of them dreamt of a certain kind of owl, which dream the wise men declared to forbode an attack from a certain other tribe.—Tylor's "Primitive Culture," vol. I., p. 121.

† Brinton's "Myths of the New World," p. 261.

‡ The Eskimo of the extreme north imagines he sees the spirits of the dead clothed in ethereal light, amusing themselves in the absence of the sun, when he sees the bright, ever-changing light of the aurora, and calls it the *Dance of the Dead*.—Brinton's "Myths," 263.

§ Smithsonian "Second Report," p. 281.

‖ Brinton's "Myths of the New World," p. 111.

¶ Among the Lithuanian's traditions the Milky Way is supposed to be the path of birds. These birds are supposed to be the souls of the departed, who fly away free and happy along this path to the land beyond.—Tylor, "Prim. Culture," vol. i., p. 159.

* "The Karens stretch threads across the brooks, in the Burmese forests, for the ghosts to pass along."—Tylor, vol. i., p. 442. And they believe that a dream "is a real journey of the sleeper's soul," for which these threads are no doubt provided.

† Schoolcraft, "Hiawatha Legends," p. 225.

‡ This would suggest the idea of punishment in after-life, but this did not form part of the belief of the North American tribes, until lately, owing to the teaching of the missionaries.

§ "The Algonquins believed that there are villages of the deceased in the sun, and the 'Milky Way' is the road that leads there. As the spirits travel along this 'Path of Souls,' to the land beyond the grave, their camp-fires may be seen blazing as brighter stars."—Tylor's "Prim. Culture," vol. i., p. 159.

From the village of his childhood,
From the homes of those who knew him,
Passing silent through the forest,
Like a smoke-wreath wafted sideways,
Slowly vanished Chibiabos!*
Where he passed the branches moved not,
Where he trod the grasses bent not,
And the fallen leaves of last year
Made no sound beneath his footsteps.†
Four whole days he journeyed onward,
Down the pathway of the dead men;
On the dead man's strawberry feasted.
Crossed the melancholy river,
On the swinging log he crossed it,
Came unto the Lake of Silver,
In the Stone Canoe was carried
To the islands of the Blessed."

"Chibiabos crossed the melancholy river." The Guinea negroes believe "that the departed shall be judged by their god at the river of death, to be gently wafted by him to a pleasant land," if they have done well, but if not, "to be plunged into the river by the god, and thus drowned and buried in eternal oblivion."‡ The Hurons believe that a tree-trunk bridges the river of death: here the dead must cross. The dog that guards it attacks some souls, and they fall.§ Most likely this is the "swinging log" referred to in the poem of "Hiawatha." "The Hurons and Iroquois told the earliest missionaries that after death the soul must cross a deep, swift river, on a bridge formed by a single slender tree, most lightly supported, where it had to defend itself against the attacks of a dog. The Athapascans (Chepewyans) also told of a great water, which the soul must cross in a stone canoe; the Algonquins and Dakotas of a stream bridged by an enormous snake, or a narrow and precipitous rock; and the Araucanians of Chili tell of a sea in the West, in crossing which the soul was required to pay toll to a malicious old woman. Were it unluckily impecunious, she deprived it of an eye." With the Aztecs this water was called Chicunoapa, the Nine Rivers. It was guarded by a dog and a green dragon, to conciliate which the dead were furnished with slips of paper by way of toll."‖

But, to return to Chibiabos:—

"On that journey, moving slowly,
Many weary spirits saw he,
Panting under heavy burdens,
Laden with war-clubs, bows and arrows,
Robes of fur, and pots and kettles,
And with food that friends had given
For that solitary journey.
'Ah! why do the living,' said they,
'Lay such heavy burdens on us!
Better were it to go naked,
Better were it to go fasting,
Than to bear such heavy burdens
On our long and weary journey!'"

This refers to the custom of making provision for the dead, and in many cases horses, dogs, and even the widow, are sacrificed to bear him company on his weary journey. In Schiller's burial song of the chieftain, translated by Bulwer, this custom is referred to:—

"Here bring the last gifts; loud and shrill
Wail death-dirge of the brave!
What pleased him most in life, may still
Give pleasure in the grave.
We lay the axe beneath his head,
He swung when strength was strong,
The bear on which his hunger fed;
And here, new-sharpened, place the knife,
Which severed from the clay,
From which the axe had spoiled the life,
The conquered scalp away.
The paints that deck the head bestow;
Aye, place them in his hand,
That red the kingly shade may glow
Amid the spirit land!"

On the north-west coast the American Indians, in burying a chieftain, would place the body in a life-like position, dressed and armed, and often as if engaged in some congenial occupation, such as hunting, fishing, &c. In some cases, horses and dogs are buried alive with the dead body of their master. In one case a chieftain desired a favourite war-steed to be buried alive under him. He owned, among many horses, a noble white steed, that was led to the top of the grass-covered hill, and with great pomp and ceremony, in the presence of the whole nation, and several of the fur-traders and the Indian agent, he was placed astride of his horse's back, with his bow in his hand, and his shield and quiver slung, with his pipe and his medicine-bag, with his supply of dried-meat, and his tobacco-pouch replenished to last him through the journey to the beautiful hunting-grounds of the shades of his fathers; with his flint, its steel, and his tinder to light his pipe by the way; the scalps he had taken from his enemies' heads could be trophies for nobody else, and were hung to the bridle of his horse. He was in full dress and fully equipped, and on his head waved to the last moment his beautiful head-dress of the war-eagle's plumes. In this plight, and the last funeral honours having been performed by the medicine-man, every warrior of his band painted the palm and fingers of his right hand with vermilion, which was stamped and perfectly impressed on the milk-white sides of the devoted horse. This all done, turfs were brought and placed around the feet and legs of the horse, and gradually laid up to its sides, and at last over the head and back of the unsuspecting animal, and last of all over the head and even the eagle plumes of the valiant rider, where all together have smouldered and remained undisturbed to the present day.*

* "It was the custom among the Algonquins and other tribes to burn the dead bodies after death. It was, however, a great distinction among the Algonquins, as only those of the distinguished totem of the Great Hare were entitled to this peculiar honour. They gave as a reason, that members belonging to so illustrious a clan as that of Michabo, the Hare, should not be put under the ground as common folks, but rise to the heavens on flame and smoke."—Brinton, p. 162.

† He had left his body behind him, and only his shadow travelled to the sun—or, rather his body had been burned, so only his shadow was left.

‡ Tylor. "Prim. Culture," vol. ii., p. 23.

§ Tylor. *Ibid.* p. 94.

‖ Brinton's "Myths of the New World," p. 266. "It was the custom of the Vikings to be buried in a boat, so that they might cross the waters of Ginungo-gap to the inviting strands of Godheim." P. 265.

ORIGIN OF COMETS AND METEORS.

By Richard A. Proctor.

On Nov. 27, 1872, the meteors following after Biela's comet were seen in tens of thousands, as predicted. A few were seen in 1879, on Nov. 28. And on Friday, Nov. 27 last, the display of Bielan meteors announced by me in the *Times* as likely to occur took place as expected, and was witnessed all over Europe. No doubt can remain, I think, in any reasoning mind that the connection of these meteors with the comet named after Biela (which should properly be called Gambart's comet, as Gambart first determined its path) has been amply established. We

* "Bureau of Ethnology," Smithsonian Institute, p. 139, for year 1880-1881

have, apart from the evidence already decisive, obtained by Olmsted, Schiaparelli, and Adams, the following points:—A comet appears, whole, in 1826; returns, still whole, in 1832; returns, but is not seen, being unfavourably situated, in 1839; returns, still whole, in 1845; but early in 1846 divides into two; returns, still double, in 1852; may or may not have returned as a double, or perhaps multiple, comet in 1859, but would have been invisible, being unfavourably near the sun on the skies; was not seen in 1866 in any form, or as a comet in 1872, 1879, or 1885; but in each of these three last-named years, when the earth passed through the comet's track, evidence was given by the appearance of falling stars that along that track meteors were travelling, in flights of many millions, far behind the parent comet. It is not merely the agreement as to the year and the day of the year, which enables us to associate the meteors with Biela's comet; they were travelling in that direction, and in that direction alone, out of millions of possible directions, which corresponded with the motion of meteors travelling along the track of the comet. We have to add to this that evidence already regarded as overwhelmingly convincing had shown other comets to be similarly followed by meteoric trains; that, in fact, so far as can be judged, it is in the nature of all comets to have such trains; and that all meteor-streams are thus associated with comets (either whole or long since dissipated). No doubt, then, as to the connection between the Andromedes of Nov. 27 and 28 and Biela's comet can be reasonably entertained.

The occasion seems a good one for touching on the remarkable nature of the problem which meteors and comets, thus understood, present. The facts collected together are so significant that we might fairly expect them to suggest the true theory of comets and meteors as clearly as—to take an appropriate illustration—the meteors seen during some great display indicate by their intersecting paths the "radiant point" of the system. If we examine carefully what has been proved, and sift carefully the theories which have seemed to be established, accepting such parts of theories as really have been established and suspending judgment as to what still remains doubtful, we shall find a singularly suggestive body of evidence in favour of a general theory which, viewed apart from such collected evidence, would appear surprising—nay, even startling—in character.

We require at starting only the following two assumptions—which may be regarded as altogether reasonable:—First, that what has been proved about comets generally may be regarded as true about meteor-systems; and, secondly, that what has been proved about meteors may be regarded as throwing light upon the nature of comets.

Now, it has been shown by the researches of Stanislas Meunier, Tschermak, and others that among the meteorites which reach our earth are bodies, ranging in structure from the asiderites (with very little iron) to the holosiderites (almost wholly iron), which are practically identical with volcanic products, ranging from the ultrabasic to the iron masses found at Ovifak, in Greenland—these last being so like the holosiderite meteors that they were long regarded as indubitably meteoric. It has further been shown that, on a careful investigation of all the evidence in regard to these meteorites and a discussion of the probabilities of their encounter with the earth on various theories as to their origin, it becomes almost a certainty that most of them not only are, as their structure shows, of volcanic origin, but were ejected originally from volcanoes on this very earth on which we live. Mr. Ball, Astronomer Royal for Ireland, has discussed the evidence on this point very soundly, though, as will be seen, he does not carry the reasoning quite as far as it may be fairly taken. Every mass, small or great, ejected from the earth by volcanic action with a velocity exceeding seven miles per second would pass away on a path thenceforth carrying it round the sun, but crossing the earth's track at or near the point where the ejection took place. But for perturbations, the crossing-place would be always at that very point; but perturbations would shift the place of crossing. Thus every meteoric mass so ejected would be exposed to the risk of recapture by the parent earth. On the contrary, the chance that a body ejected from any other planet whatsoever would fall on the earth would be almost infinitesimally small. Thus, while a comparatively small amount of terrestrial ejections would serve to account for the considerable number of meteorites captured within historic times by the earth, we should have to imagine an almost infinitely large number of ejections from any other planet to account for so many captured meteorites (since for each one captured by the earth millions of millions must have been ejected by that other planet if all of them came from it).

So far we are on tolerably sure ground. Yet already we have deduced a very surprising result. Nothing in the present activity of volcanoes would suggest an eruptive power capable of ejecting matter with a velocity of seven miles per second, or more. Yet, remembering the evidence we have that the earth was once in a *quasi*-sunlike state, we can well believe that in her sunlike youth she may from time to time have so concentrated her volcanic energies as to expel matter even with the tremendous velocities indicated by Ball's, or rather Tschermak's theory. Possibly, turning presently to a body which actually is in a sunlike state, we may find evidence showing that this is the way with sunlike orbs.

Here Tschermak and Ball pause. Content with showing that probably many millions of meteoric bodies were ejected from our own planet when she was a small sun, they overlook the inference that what she could do the other planets could presumably do also. Mr. Ball, indeed, while admitting the possibility of this in the case of planets no larger than the earth, expresses the opinion that the giant planets could not expel volcanic products with the much greater velocities necessary to overcome their own much greater attractions. He overlooks, apparently, the circumstance that if much greater power would be required much greater power existed. The volcanic energies of a planet result from the planet's internal heat, and the internal heat is now recognised as a direct product of the planet's gravity. It would seem highly probable, then, if not certain, on *à priori* grounds alone, that the giant planets would be able, like the earth, to expel millions of millions of meteoric flights from their interior during their sunlike youth—possibly not yet altogether past.

Turning next to direct evidence, we find that among the multitudinous comets belonging to our solar system can be recognised certain families dependent on the giant planets in a somewhat peculiar manner. Long before the significance of the feature had been noticed, I wrote of "The Comet-families of the Giant Planets" as a phenomenon needing to be inquired into. The comets thus classed into families travel around the sun as their ruling centre, but with paths passing near severally to the track of one or other of the giant planets—Jupiter,

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Saturn, Uranus, or Neptune. Near, too, as the approach is now, we may reasonably assume that this nearness of approach indicates actual intersection at some remote time in the past. The resemblance between this peculiarity, and the intersection of earth-ejected meteor-streams with the earth's orbit, according to the theory of Tschermak and the Astronomer Royal for Ireland, need hardly be insisted on. If, as they consider almost certain, the meteor clouds vomited forth by the earth in long-past ages became meteor streams travelling round the sun, but always passing near the earth's orbit, then the more important meteor clouds expelled by the giant planets would become more important meteor systems travelling round the sun, but ever thereafter passing near the track of the planets from which they had severally been expelled. And, in one case as in the other, the meteor stream would imply a comet, for we have every reason to infer, from what we know about meteors and comets, that every meteor system is probably associated with a comet. Indeed, two of the meteor systems actually identified as attendants on comets, follow severally in the tracks of comets belonging to the families of the giant planets —the meteors of November 14 following in the track of Tempel's comet which passes very near the orbit of Uranus, and the meteors of November 27 following the track of Biela's comet which passes very near the orbit of Jupiter.

I am fully aware that another explanation—only one other seems even possible—has been suggested for the strange way in which comets and meteor systems cling around the orbits of the planets. This other explanation has even been sometimes described — though quite erroneously—as the accepted theory. It was advanced by Schiaparelli as an adjunct of the theory—which really has been accepted, because demonstrated—that meteors and comets are associated. He suggested that the meteor systems which now pass near the paths of the giant planets may have been drawn into the solar system by the perturbing action of those planets near which, on their parabolic course around the sun, they chanced to pass. But while this explanation gives no account whatever of the structure of meteoric bodies, it even fails to account for meteoric streams as we know them. It has been shown (with mathematical demonstration) that no flight of meteors could ever, by the attractions of a giant planet, be so perturbed that all its members would thenceforth travel on practically the same orbit round the sun. Those passing nearest to the disturbing planet would inevitably be sent off on a different path from those which were in the middle of the approaching flight, and these on a different path from those farthest away, unless the flight were very small indeed, in which case its members would be kept together by their mutual attractions and no meteoric stream would be produced.

On the other hand, the theory I have advanced, while itself suggested, and almost demonstrated, by *à priori* evidence, explains perfectly the structure of meteors, and accounts for the eventual conversion of a flight of meteors (vomited forth in the form of a meteoric cloud in some immense eruption) into a meteoric stream.

But we cannot stop here. There is a test which this theory, if sound, ought assuredly to bear. There are orbs actually in the sunlike stage—to wit the stars, and our own star (the sun) in particular. These ought to be actually doing what we have found such strong reason for believing that our earth did in the remote past, and the giant planets (still in the youth of their much longer lives) did, not so very long ago. They ought to be ejecting occasionally vast flights of meteoric masses from their interiors. Our sun, no doubt—to take him as an example—would have to eject such masses with far greater energy than the earth must have employed during her sunlike youth, to send them beyond his own control. For whereas seven miles per second would have sufficed in the earth's case, 382 miles per second would have been required in the sun's. But then the sun is 327,000 times as massive, and therefore as mighty, as the earth, and no doubt volcanic ejections resulting from that vast strength would, in adequate degree, surpass all that our earth could have done, even in the fulness of her youthful energy.

We turn our telescopes, then, on the sun to see whether he ever does such amazing expulsive work as this requires of him, perhaps hardly expecting to find signs of it. But lo! he has been detected in the very act. He has been caught ejecting flights of bodies from his interior with velocities so great that not even his mighty attractive power could ever bring them back again. In one such outburst velocities of 450 miles per second at his visible surface were indicated, which would be 68 miles per second more than would be required to take such matter for ever away from him. This evidence would in reality suffice if it stood alone to account for all the meteoric phenomena we have been dealing with. If he does this now he must have done the like during all the millions of years of his past existence as recorded on the tablets of the earth's crust. If our sun does this, so must his fellow suns, the stars, and they also during millions of past years. Billions of billions of billions of sun-expelled bodies must therefore be travelling in multitudinous courses through interstellar space. And from this we can reason back to the very theory of planetary and terrestrial ejection of meteors to which we had been already led, and from which we had reasoned on to solar ejections.

This theory of the volcanic origin of meteors, and therefore of comets—for without comets there are probably no meteors, and without meteors no comets—is singularly confirmed by the microscopic and chemical examination of meteorites. For Mr. Sorby long since (1864) announced that the microscopic structure of some meteorites revealed their past existence in the form of clouds of globules of molten metal, a state in which, as he said, they could not have ever existed except in the interior of a body like our sun; while in 1867, Professor Graham, exhausting the air around the Lenarto meteor, heated to redness, found hydrogen coming forth in such quantities as to show that that meteorite had "brought to us across the interstellar depths the hydrogen of some fixed star"—which could have happened no otherwise than through expulsion.

Meteorites, meteor-streams, and comets would appear, then, to be products of expulsion from suns, from giant planets, and from orbs like our earth when in the sunlike state.—*Times*.

BAD TIMES.*

THE interpretation given by Mr. Wallace to the prevailing depression of trade is too near the truth to be so popular as any of the various opposing theories over which party politicians have contended. He goes to the root of the matter: it is a far more popular plan to strike at symptoms.

* "Bad Times: an essay on the present depression of trade, tracing it to its sources in enormous foreign loans, excessive war expendi-

He discloses the rottenness of what the multitude regard with fond admiration, the folly of what they regard as the essence of worldly wisdom, the essential weakness of what they regard as symbolical of might. We doubt if his book will be popular; but we are certain that it ought to be, if the many knew their own interests. We can understand that as an essay written in competition for the prize of one hundred pounds offered by the great advertising soap company, this essay (which in one chapter insists on the inherent vice of certain modern trading methods) would have no chance of success. But we are certain that nothing yet said about the depression of trade by politicians has been better worth close and careful study than what has been here advanced by an eminent naturalist,—the secret of whose success in dealing with his subject has been that he has applied to it the strictly scientific method.

Mr. Wallace rejects the popular explanations of the depression, without denying the influence which over-production, Protection as against British trade, Protection as injuring other countries, bad harvests, disturbances of the currency, and other such causes may have exerted. He urges the just objection that the influence of these causes does not synchronise with the progress of the depression which they have been called on to explain. They existed before it began, or started after it was already in progress. This objection is justified by the methods of scientific reasoning. The depression has been too definite in character, too marked in its rise, culmination, and in at least the beginning of its diminution, not to suggest that the cause or causes, whatever they may have been, must have originated and progressed *pari passu* with the effects.

Some at least of the causes suggested by Mr. Wallace have probably been much more potent in their influence than those commonly alleged.

In the first place he calls attention to the mischievous effects of great loans to foreign nations, and in particular to the more rotten sort of despotisms. During the years 1870-75 there was a mania for foreign Government loans, which England advanced to the tune of 260 millions, besides large sums advanced for foreign railways and other undertakings. In so far as such loans were directed to advance commercial projects their influence could not be bad. But the greater part of the Government loans, and no inconsiderable portion of the rest, went to strengthen the influence of despotisms and to supply means for the lavish expenditure of persons who care little how they squander money for which others will have to pay. For a time, doubtless, there was a sudden inflation of trade, though it required but a careful study of details to see that the growth of trade "by leaps and bounds," as Mr. Gladstone expressed it, implied no trustworthy progress. Shortly came the inevitable reaction. The money advanced had been in the main squandered. The interest—heavy or the advance would not have been obtained—had to be met by grinding taxes. The bulk of the foreign populations, on which we really rely for our foreign trade—the business supplied by the ruling bodies being by no means permanent—have been unable, owing to the pressure put upon them by the despotisms under which they groan, to be such good customers as they had been before.

Associating with the effect of foreign loans the influence of increased war expenditure, which we may justly do when we consider in how large degree the loans have been raised to meet or to anticipate military expenses, we have only to consider the increasing annual expenses of the principal European countries, to see how seriously the moneys raised by loans are in the first place needed, and in the second place squandered,—for all abnormal increase of expenditure may safely be regarded as implying corresponding waste:—

Our own annual expenditure increased between 1870 and 1884, from 75 to 87 millions, or 16 per cent. This, being less than the increase of our population in the time may be regarded as reasonable, the real trouble with us being not the rate of increase during the last fifteen years, but the already high revenue raised before that time for purposes not wholly beneficial to the nation at large. So far as our revenue has been concerned—and fortunately with us revenue and expenditure correspond pretty closely—we may be content; the results observed are not unworthy of a free nation and a civilised community. But turn now to foreign continental nations, and we find results which cannot but be considered as discreditable to the rulers of the nations concerned as they have been mischievous to the subject peoples directly, and indirectly to ourselves. The annual expenditure of Austria has increased from £55,000,000 to £94,000,000, or 71 per cent.; that of France from £85,000,000 to £142,500,000, or 68 per cent.; that of Germany from £54,000,000 to £112,500,000, or 108 per cent.; that of Italy from £40,000,000 to £61,500,000, or 54 per cent.; and that of Russia from £66,000,000 to £114,500,000, or 74 per cent. The increase of the expenditure of the five chief continental powers has been from £270,000,000 to £525,000,000, or no less than £255,000,000 per annum, or considerably more than £1 per head of the population The State taxation has nearly doubled, and local taxation has in many cases increased in yet greater degree. Can we wonder if the populations of those countries are less profitable customers than they formerly were?

There is this further mischief, that by having so much British money invested in these foreign loans, applied partly in ways altogether alien to our own ideas of what is right and just, it becomes our interest to support the Governments of those countries as against their peoples, from whom alone the interest of our loans can be raised. When this consideration is extended to certain Governments which are not partly but wholly and absolutely iniquitous, we recognise still more disastrous effects from our undue readiness to advance money to every foreign nation ready to offer a sufficiently high rate of interest,—or in other words ready to afford sufficiently obvious evidence of unworthiness.

Military expenditures in themselves present a most painful subject for study: but it seems idle in the present condition of the human race, even in communities regarding themselves as cultured, to dwell on the melancholy spectacle of the energies devoted by races claiming to be not only civilised but religious, on the business of destruction. Viewed from outside, as by an inhabitant of another planet, many of the leading nations of the earth seem to regard the human race as most nobly employed in striving to destroy itself off the face of the earth. That the rapid growth of armies and armaments on the continent of Europe, since the wars by which Germany has of late acquired an unenviable reputation for able savagery, has had much to do with recent commercial depression, no one can deny who considers the utterly unfruitful character of even the work of production as applied to warlike preparations.

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ture, the increase of speculation and of millionaires, and the depopulation of the rural districts, with suggested remedies." By Alfred Russell Wallace. (Macmillan & Co., London.)

Rural depopulation which Mr. Wallace regards as a cause, seems to us to be more appropriately viewed as an effect of commercial depression. It acts doubtless, as all effects act, in turn, as a cause. But it began with the falling off in trade, of which it was a direct effect. How it operates, however, let it have been brought about as it will, may be seen when we note that the importation of bacon and pork rose from 863,000 cwt. in 1870 to 5,007,000 cwt. in 1883; potatoes from 127,000 cwt. to 4,034,000 cwt., and eggs from 430 millions to 814 millions. Unfortunately such results as these, rightly apprehended, tend to show how long-lasting must be the effects of such depression as has affected our trade during the last ten years. The rural population, driven into the cities by want, will not be restored to rural districts when commerce begins to revive.

In regard to agricultural depression and its causes, Mr. Wallace is in favour of small holdings free from risk of change. He holds with Mr. Barclay that with continuity of occupation and fair rents fixed for long periods and never to be raised on account of improvements effected by the occupier, our land is capable of well repaying the expenditure of labour and capital in its cultivation. The trouble is, that if rents are to be fixed for long periods, the determination of the amount becomes a matter of speculation: and there must inevitably be serious loss either to the tenant or to the landlord in a great number of cases. This may be a less serious mischief than the trouble arising from the unwillingness of the tenant to introduce improvements for which he will eventually have to pay an increased rent, or from the readiness of too many landlords to take to themselves the profits which the tenant is justly entitled to obtain from his own improvements. The whole subject is full of difficulties; and unfortunately the method which seems suggested as the only fair way of meeting the chief difficulty, *i.e.*, enabling all who will to become purchasers of land in perpetuity, at reasonable rates, savours too much of communism to commend itself to general approval. Legislative enactments have proved too often delusive, if not injurious, to be regarded as hopeful means for improving the state of affairs. But the mischief is serious and pressing. So long as a few wealthy landholders have absolute command over a large proportion of the land available for agricultural purposes, with rentals so large as to be free (if they prefer it) to convert crop lands to grass lands, or even grass lands to waste, there will be an ever-growing feeling that there is wrong done to the many. It is manifestly no longer a sound answer to say that because it is the interest of every great landowner to make the best use of his land, room will always be found for a rural population. This is no more true than the argument that slavery is on the whole beneficial because it is the interest of the owners to treat their slaves well. A man who might obtain £200,000 a year from agricultural tenantry on the larger portion of his land, may prefer to sacrifice half this amount in order to have the best portion of his estates free from all signs of agricultural labour. He may regard the money so lost as money devoted to his own special gratification, and the satisfaction accruing to himself as worth the sacrifice. Many certainly do so view the question; and though when this purely selfish way of considering the matter is pushed to an extreme point, as by a wealthy American *parvenu* now dishonouring the old country (and his own) by his presence among us, the community is disgusted, it may be feared that the less obviously displeasing examples afforded by many of our own large landholders are not viewed with the disapproval they merit.

Mr. Wallace considers the existence of millionaires in increasing numbers as among the causes of the general depression of trade. We have here a cause corresponding in some degree in character to the last. The man who has made an immense property by trade (for millionaires of this class are chiefly to be considered, as the only body greatly increasing at present) has free power to use his property as he will, to let it lie idle if he so pleases, to use it in trade with power to wait always for the most profitable markets and to take fullest advantage of the necessities of the many with whom he has to deal, and in other ways to affect mischievously the general progress of trade, either at his own cost (which he can easily afford) or at the expense of others. It cannot be doubted that many millionaires in this country, and still more in America, do thus check the diffusion of wealth; while further by the amount of money devoted to pleasures or luxuries they diminish, directly and indirectly, the amount available for the consumption of the necessaries and comforts of life, and thus seriously help to bring about and extend the depression of trade.

Mr. Wallace dwells justly on the mischievous increase of speculation and finance. It would be difficult to say of how many millions the middle and lower classes of the community in this and other countries are annually robbed, through the temptations held out by the financiers of bubble companies. The effects of the "Limited Liability Act" intended to save those classes from ruin through speculative investments, illustrate admirably Mr. Spencer's argument against legislative interference; for so far from diminishing the evils it was intended to prevent, the Act has intensified them a hundredfold. And if the Act be now repealed hundreds of innocent persons, as well as promoters, directors, and other agents for swindling companies, will suffer from the change. There can be no doubt, however, that mischievous though some of the effects of the repeal of this unwise Act would probably be, they are not to be compared with the mischievous effects resulting from the maintenance of the law unchanged. Hundreds of thousands have been ruined by this piece of so-called protective legislation.

That lastly trade has suffered seriously from adulteration and dishonesty no one can doubt, though this particular cause is by no means new. Builders and contractors were many of them rascals in Norman days, as our old cathedrals testify; and we cannot wonder if among the representatives of British trade to-day are many dishonest men. The adulterator asserts that there is a demand for his villanous merchandise; but possibly if he were obliged to describe his commodities as they actually are, he might not find a very great demand for them. Goods marked "Calico, 90 per cent. China-clay, lime, and size"; "dyed calicoes, warranted not to stand one washing"; "wool, four-fifths shoddy"; "silks, 50 per cent. dye stuff"; "cutlery, warranted not to cut," and so forth,—would possibly not have the satisfactory sale obtained when, as now, the same goods are called "superfine," "all wool," "best Sheffield steel," and so forth.

That in other countries, and especially in America, protection has had much to do with trade depression is no doubt true; but we have enough within our own control to which we may attribute the badness of the times without looking outside, or endeavouring to set matters right by injuring ourselves further through retaliatory tariffs.

XUM

GEOLOGY IN LONDON.

By W. Jerome Harrison, F.G.S.

[Before writing the Geology *of* London, I think it will be well to say a few words about Geology *in* London, explaining the facilities which the metropolis affords for acquiring, or adding to, a knowledge of that science.]

MANY a dweller in London has, to my knowledge, scorned the idea that he, or she, was favourably situated for acquiring a knowledge of geology. "What can I do among the bricks and mortar!" they exclaim; and they envy the lot of those who live in wild Wales or stony Scotland, where the opportunities for studying the rocks are, they think, so very superior.

But it is of no use to be surrounded by quarries and cliffs unless the power of understanding the phenomena they exhibit has been, or can be, acquired. Teachers must be at hand, and museums must be accessible, if the way of the tyro is to be made smooth. As a place for learning geology I know of no district to equal London. As a home for the advanced student of the science London is equally desirable, with its grand collections of books and specimens, and the opportunities afforded by its scientific societies for the meeting of kindred spirits. Many a man of science has made great sacrifices in order to be able to dwell in London, and avail himself of these advantages.

Let us see, first, what public collections of geological specimens exist in London.

THE MUSEUM OF PRACTICAL GEOLOGY, JERMYN STREET.

The most central is the Geological Museum in Jermyn-street. We owe this fine building to the energy of the late Sir Henry de la Beche, the first Director of the Geological Survey. The museum was opened by Prince Albert in 1851. It is free to the public on Mondays and Saturdays, from ten to ten; and on other days (Friday excepted), from ten a.m. to four or five p.m. The building is illuminated, on the two evenings on which it is open weekly, by the electric light.

The present Curator, Mr. F. W. Rudler, is not only among the most able, but is one of the most courteous of museum-keepers; his kindness and patience are as inexhaustible as his knowledge, as I—with many others who have "wanted to know"—can gratefully testify.

Adjoining this museum is the headquarters of our national Geological Survey. Its officers are ever examining the strata in some part or other of England, and all the specimens of rocks, fossils, and minerals which they collect are sent up to Jermyn-street, there to be named and catalogued; while the choicest specimens are placed in the museum cases. In this way, aided by purchases and by numerous bequests—one of which alone, the Ledlam collection of minerals, is of the estimated value of £15,000—the Jermyn-street Museum has acquired a magnificent and very extensive series of specimens illustrating mainly British geology. In the well-written "Descriptive Guide" of nearly two hundred pages (price sixpence) a full account of the contents of the building is given. In the entrance hall the building and ornamental stones of the United Kingdom are exhibited; upstairs, on the principal floor, is the grand collection of minerals, which are worth viewing, if only for their beautiful forms and colours. Here, too, are some memorials of Sir Roderick Murchison, the splendid vase of avanturine, and other objects presented to him by Nicholas, Emperor of Russia. Close to this vase is a geological model of London, embracing about 165 square miles, and offering, as far as may be, a really "royal road" to the understanding of the arrangement of the strata in and around the metropolis. This model not only shows the rocks which are at the surface, but its sides reveal the strata to a depth of 1,000 feet. It is in nine sections, any one of which can be raised for separate examination. The light iron galleries which surround the hall rise tier above tier, and the cases which they contain include many thousands of specimens of rocks and fossils, each carefully labelled and arranged in stratigraphical order; *i.e.*, the fossils from the oldest rocks come first, and are placed as one group; and so on, up to those which we know to be of comparatively recent date. Here the student may bring his "find," and it must be rare indeed if it cannot be matched, so that he is enabled to learn its name and nature. Besides the geological collections, the Jermyn-street Museum contains a large and valuable collection of British pottery, porcelain, and glass. There is a fine library, accessible to all who state the object with which they wish to consult the books; and a lecture-theatre in which science-lectures are delivered during the winter to crowded audiences of working-men. Besides the General Guide already named, there are six printed catalogues, describing very fully the various collections. The Jermyn-street Geological Museum is certainly an institution which no one can visit without obtaining both profit and pleasure.

THE NATURAL HISTORY MUSEUM, SOUTH KENSINGTON.

The great and continually increasing pressure on the rooms of the British Museum in Great Russell-street, long ago determined the trustees to find accommodation elsewhere for the natural history collections, and in 1881 they were transferred to the magnificent terra-cotta building erected from the designs of Mr. Waterhouse, in Cromwell-road, South Kensington. The guide-books which have been written to the various galleries here are so admirable, and withal so cheap, that we strongly recommend every student to send for them, whether they ever intend to visit the Museum or not. They include a guide to the galleries of Geology and Palæontology (3d.), the Mineral gallery (3d.), Meteorites (1d.), Fossil Fishes (3d.), and index to the collection of Minerals (2d.). The principal workers by whom the collections have been arranged and the guide-books written, are Dr. H. Woodward, and Messrs. L. Fletcher, R. Etheridge, T. Davies, and W. Davies. Dr. W. Flight, whose knowledge of meteorites was simply encyclopædic, has died quite recently. The specimens here are great in number, and probably unequalled in the world for rarity, size, and beauty. The fossils are arranged zoologically, all the members of each genus, order, family, &c., being placed together; a plan which forms the complement to that adopted at Jermyn-street, where, as we have seen, the fossils are classed stratigraphically. The collection of meteorites includes "air-stones" which have fallen in all parts of the world, some being of great size and weight.

This museum is open every weekday from 10 a.m. to 4, 5, or 6 p.m., according to the season of the year; and on Mondays and Saturdays till 8 p.m. in summer, and 7 p.m. in winter.

THE MUSEUM OF THE GEOLOGICAL SOCIETY.

In the rooms of the Geological Society, at Burlington-house, Piccadilly, there is an extensive geological collection, intended especially to represent and illustrate the papers on geological subjects which are read to the

Society. With an introduction from a Fellow, the specimens can be examined between ten and five daily. The library of geological books, of which an excellent calalogue has been printed, includes about 30,000 volumes.

LONDON DEALERS IN GEOLOGICAL SPECIMENS.

Prof. Tennant, whose shop in the Strand, near King's College, was so well-known a resort, has gone from among us, but Mr. Henson, at 277, Strand, may be considered to have supplied his place. Mr. Henson's specialty is rare and valuable minerals. To Mr. R. Gregory, of 88, Charlotte-street, Fitzroy-square, I have been indebted any time this twenty years, not only for excellent and cheap specimens, but for the freedom with which he has permitted me to draw upon the remarkable practical knowledge of rocks, minerals, and fossils of which he is possessed. Then there is Mr. Bryce-Wright, of 90, Great Russell-street, and Mr. Russell, 78, Newgate-street. Any or all of these dealers can be relied on to furnish typical and correctly-named specimens of rocks, fossils, or minerals at a moderate price—from sixpence to one shilling each for the commoner varieties.

THE MIGRATION OF ABRAM.—A paper on "Historical Evidences of the Migration of Abram" was read on Monday night by Mr. W. St. Chad Boscawen at a meeting of the Victoria Philosophical Institute, in the hall of the Society of Arts, London. Mr. Boscawen reminded his hearers that only of late had the grave-mounds of Chaldea yielded the monuments and inscriptions which the decipherer had revivified by his almost magic skill, forcing them to become witnesses in the cause of truth (hear, hear). This series of historic records extended over twenty-five centuries in almost unbroken sequence before the Christian era. Having minutely examined the testimony of the monuments with reference to the Hebrew account of the migration of Abram, Mr. Boscawen said there were inscriptions to prove the existence of a Semitic population in the city of Ur of the Chaldees as early as 3750 B.C.—a people who spoke a language closely akin to Hebrew, and bore names similar to those of the early Hebrew patriarchs. In religion, though not monotheists, they certainly had a purer creed than that of their Turanian-Akadian fellow-countrymen; and at the head of their pantheon was the supreme god Ilu or El, whose name, like that of El and Jehovah, entered into the composition of many personal names. In the year 2280 B.C. Chaldea was invaded by the Elamites, who established a dynasty of their kings. The fall of this dynasty, caused by the defeat of Kudur-Mabug and Eriaku or Arioch by Khammurabi in 2120 B.C., seemed to synchronise very well with the defeat of Chedorlaomer, recorded in Genesis xiv. The migration of Abram must therefore fall within this period of 160 years. The monuments showed that at this time such an alliance of Mesopotamian kings as that recorded in Genesis xiv. was most probable. The invasion of Chaldea by the Elamites and the conquest of Syria by those kings synchronised well with the date of the Hyksos invasion of Egypt—the date when Abram would have entered Egypt under the most favourable circumstances. The invasion of Chaldea and the conquest of Ur, Erech, and Babylon by Elamites would press more severely on the Semitic than on the non-Semitic population, forcing them to migrate northward. The close religious affinity between the worship of the temple at Ur and that at Harran would render the migration of this people from one city to the other most probable. All these points taken together tended to show that the record of the migration of Abram in Genesis agreed perfectly with the Chaldean and Western-Asiatic history revealed by the monuments (cheers). The chairman stated that Professor Sayce, who was in Egypt, had sent a communication criticising Mr. Boscawen's dates, but evidently not disputing his facts. They might therefore congratulate themselves upon his attitude, as everything that proved the reliability of the Bible was most important (hear, hear). Mr. E. A. Budge agreed generally with Mr. Boscawen, that the record in Genesis was proved to be correct. The Rev. Dr, Wright, M. Bertin, and other gentlemen also spoke. Several references were made during the evening to the urgent need of excavations in the great city mounds of Western Asia, especially in ancient Kharran, and to the fact that English discovery had been at a complete standstill for four years, in consequence of our Government being unable to secure the necessary firman from the Porte.

OUR MAMMAL COUSINS.*

THIS work is intended to meet a decided want. It deals primarily with the mammals in their relation to the earliest ages of animal life upon the earth. But while it thus only relates to a limited field, it presents an important general lesson, as well taught thus by a typical example, as it could be by studies ranging over a wider area. This is the truth, constantly overlooked by opponents of the doctrine of biological evolution, and often overlooked by supporters (among whom are many who have little knowledge of the actual nature of the theory they support)—that the various races now present on the face of the earth have certainly not descended along lines of which living examples remain. Again and again we see the mistake made of presenting as the true course of descent for the more advanced races now existing, a sort of traverse line athwart the various less advanced races. It is as though an insect living within the domain formed by a vast tree should trace the history of some particular set of leaves by regarding them as directly related to another set of leaves in a remote part of the tree, instead of tracing the development of each set along the twigs, sprays, branchlets, branches, boughs, &c., to the parent stem,—though indeed this parallel indicates but an infinitesimal part of the complexity of the actual problem.

Professor Oscar Schmidt, whose "Doctrine of Descent and Darwinism" (in the same series as the present work) is well and favourably known, deals in this volume with the Mammals, and shows how vain have been the attempts of naturalists in former times to bridge over the gap separating the mammalia from the other vertebrates of the present day, and that the difficulty is not at all or but little removed by our present knowledge of primæval times. He considers the various isolated forms within the class of mammalia. Thus the horse and its relatives are set by the side of the two-hoofed animals; but the differentiation of the one-toed horse from the two-toed oxen and stags remains completely unexplained, while the dentition of the horse separates it much more strikingly from the ruminants than from other animals which zoologists set much farther from the horse. Again the so called many-hoofed animals present no unity among themselves, the class including genera which differ from one another in structure, feet, and teeth, more than do the members of orders not set far apart by the descriptive biologist.

Geographical differences still further increase the difficulty of arranging the various classes of mammals as they exist at the present time. We find examples in different continents not only of associated races, but of races which are, in fact, one, wherein, nevertheless, differences of detail may be recognised which are as marked as those by which distinct genera are separated within a limited area. Then we have difficulties higher than those of mere classification, when we consider such a problem as, for example, the existence of kindred races of fresh-water fish in rivers between which there is now no connection except by seas, in which, at present, these races cannot live. We cannot possibly trace the descent of a fresh-water fish in European rivers from a fish of the same race in American rivers (or *vice versâ*); yet of their kinship, the scientific as distinguished from the

* "The Mammalia in their Relation to Primæval Times." By Oscar Schmidt. Kegan Paul & Co., London.

merely descriptive zoologist can have no manner of doubt.

On a still more limited field than that with which Prof. Schmidt here deals, Prof. Mivart indicated what he maintained to be a difficulty in regard to the kinship of men and apes. He pointed out that while man is nearer to the Gorilla in some respects than to any other of the anthropoid apes, he is in other respects nearer the Chimpanzee, in others to the Orang, in others to the Gibbon, while in some respects he is nearer to lower orders of Simians or even to the Lemurs. If Darwinism predicated descent along lines which can be traced even now, the objection would have had some force. But the theory of evolution as advanced by Darwin involved no such fallacy, and in reality Mivart's objection had no more weight than would an objection have against the theory of the kinship of the present races of man which should show that in some respects the Caucasian is nearer to the Mongol than to the Ethiopian type, but that in other respects the order of resemblance is reversed. In fact, it might with equal reason be urged that a man is not a blood relation of the members of a family really his third or second cousins, because in some features he is much more like some members of that family than the rest, but in other features he more closely resembles other members of the family.

Professor Schmidt by indicating the features of resemblance and difference found among various families of mammals—as among the two-hoofed animals (the Pigs, Hippopotamus, Ruminants, Camels, Deer, Antelopes, Oxen, and so forth), the one-hoofed animals (Tapirs, Rhinoceros, Horse, &c.), the Elephants, Sirenia (Sea-cows), Whales, Flesh-eaters, Seals, Insect-eaters, and Anthropoids, brings out very clearly the impossibility of all attempts at thwart co-ordination. Clearly that is to say when the evidence is understood, and duly weighed. We cannot say much for the clearness of his style, while occasionally the defects of the English translation go far to render his meaning even more obscure than a certain undue reliance on the analytical powers of his readers has made the original. Of verbal faults, bad English, and so forth, we need say little perhaps: since if, for example, he is made to say at p. 87 that "the absence of teeth in the jaws of the monotrema is distinct from the ancestors of toothed mammals," every reader knows what he means. It is different, however, with such a passage as the following:—

"When comparing the genuine Hoofed Animals with their ancestors, it was seen that the loss of one or two toes took place as early as in the first Tertiary division. It was only single genera that still showed the old five-toed extremity, an inheritance from Pre-Tertiary times. However all the living Sirenia possess a five-fingered hand. When therefore it is said that the molars of Prorastomus [an old tertiary group of Sirenia] are genuine ridged teeth, these do not point to the true Lophiodonta and tapirs, with their already reduced hand, but to earlier ancestors on both sides. Thus things no longer existing point to that very distant past, which extends back beyond our actual observation. Even in the case of Halitherium all that is left of the hind limb is the thigh bone. This bone, however, is still attached to the pelvis, which is tolerably reduced, and has a socket. The earliest Sirenians, therefore, had a less striking form of skull, but nevertheless, in their whole appearance were already like the present living species. From this it follows that the four-footed mammals changed their abode for the sea, and lost their hind limbs, before the Tertiary period."

All this is very clear to the student of zoology who has already clear ideas as to the significance of the various forms of evidence; but we fear that it must be rather hard reading for the general reader, to whom the *sequiturs* appear by no means so obvious as Professor Schmidt seems to think them.

A Positivist View of the Sermon on the Mount.—"The Gospel (I say it in no contemptuous sense) is the religion to-day of *women;* for women, at least for the present, are so much less called to public duties than are men. But does the 'Sermon on the Mount' make good citizens to-day? Did it ever make them? The 'Sermon' of Jesus is full of refined and purifying sentiments; there are counsels too often forgotten, as where it is said—'Whosoever shall say to his brother Raca, or thou fool, shall be in danger'; and—'Let your communication be yea, yea, nay, nay: for whatsoever is more than these, cometh of evil.' That, no doubt, is still useful counsel; but is it the priests of the Gospel whose communication in political strife is ever—yea, yea! and never Raca, or 'thou fool'? And when we go to the other precepts of the 'sermon'—'Resist *not* evil!' 'Resist *not* evil!' 'Turn to the smiter the other cheek also!' 'Give to him that asketh thee.' 'Take no thought for your life.' 'Take no thought for the morrow; for the morrow shall take thought for the things of itself. Sufficient unto the day is the evil thereof.' What teaching is this? Prudence, energy, foresight, practical wisdom, severe justice, worldly sagacity, all the stern virtues of the manly citizen, actually denounced as sin! I do not doubt that there are profound elements of personal purification in this supernatural trance—so there are in the ineffable ecstasies of a Buddhist mystic, or a Mussulman dervish—but how utterly incompatible with politics or any useful conduct in the social world! There may be practical and sensible Christians, and the Gospel may not altogether exclude courage and energy in politics; but it is in spite of the creed, not by the aid of it, by strange perversions and adaptations of its literal sense. The active devoted citizen not only gets no guidance whatever from the 'Sermon on the Mount,' but almost every public act of his life is a violation of its precepts, to be justified only by the argument that its precepts are an impossible form of mystical extravagance. It must always be so where religion rests on any theological basis whatever. Theology, and supra-mundane sanctions, ecstatic bliss, eternal torments, absolute transcendental objects of worship, of themselves exclude all healthy and rational politics. They act with potent, though spasmodic, effect on the individual soul, the sense of sin, the voice of conscience, the desire of purity, and thirst after righteousness. But bring them to public life, and the charm is snapped. The care for our souls, the hope of glory in Heaven, the preposterous hyperboles of all the gospels and the priests, have no common ground with prudent citizenship. Either they lead us off from any interest in these worldly things; or, if they bring us to worldly things at all, it is to present them in theological, clerical, or ecclesiastical lights. What can the welfare of England, or the sympathy of classes, or the reform of taxation, matter to men who teach that in a brief span we shall all be with the Angels or the Devils, forever and forever; to whom the Saviour of mankind has committed the task of cursing those who take a different opinion from theirs."—Mr. Frederic Harrison *on the Religion of Humanity.*

Gossip.

By Richard A. Proctor.

I am a little troubled about the Victoria Institute. I fear that society is not going quite in the way originally intended for it. A paper was recently read before the society which seems open to decided objections, by those who insist upon the literal accuracy of Bible statements. In this paper Mr. St. Chad Boscawen pointed to monumental evidence proving that from as early a period as 3750 B.C. there existed a Semitic population in the city of Ur of the Chaldees, whence the Bible says that Abram's family sprang. "The inscriptions found at the neighbouring city of Larsa, relating to the trade and commerce of its people, showed them to have spoken a language akin to the Hebrew, and to have borne personal names strikingly like those of the Hebrew patriarchs. In religion, though not Monotheists, they certainly had a purer creed than that of their Turanian-Akkadian neighbours, and at the head of their Pantheon was the supreme God Ilu or El, whose name like that of El and Jehovah among the Jews, entered into the composition of many personal names." Mr. Boscawen went on to show that in 2280 B.C. Chaldæa was invaded by the Elamites, and a dynasty of Elamite kings was established, of which Kudur-Mabug and Eriaku, or Arioch, were members, "The fall of this dynasty caused by the defeat of Kudur-Mabug and Eriaku, by Khammurabi in B.C. 2120, would seem to synchronise well," said Mr. Boscawen, "with the defeat of Chedorlaomer recorded in Genesis xiv. The migration of Abram must therefore have fallen within this period of 160 years."

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All this looks at first "very pleasant and conformable." The various points considered in Mr. Boscawen's paper may be considered, as Mr. Boscawen claims, "to show that the record of Abram's migration in the book of Genesis is in perfect agreement with the state of Chaldæan and Western Asiatic history revealed to us by the monuments." With excellent Bishop Peter of Rumtifoo, "I do not say it ain't; but *time* my christian friends!" A Semite population in the year 3750 B.C., and Abraham migrating into Egypt between 2280 and 2120 B.C.! Shem was the only Semite living at the time of the Flood. Now the bible says distinctly that two years after the Flood Arpachsad was born; thirty-five years later Shelah; thirty years later Eber; thirty-four years later Peleg; thirty years later Reu; thirty-two years later Serug; thirty years later Nahor; twenty-nine years later Terah; and seventy years later Abram, Nahor, and Haran. This gives (throwing one year in between each birth) not more than 300 years from the Flood to Abraham's birth (which happened therefore fifty years before Noah died). Now Abraham only lived 175 years, dying therefore not more than 475 years after the Flood (and twenty-seven years before Shem himself). How Mr. Boscawen and the Victoria Institute can reconcile these figures with the existence of a Semitic race 1,530 years before the earliest possible date for Abraham's migration, passes all comprehension. The call of Abraham took place when he was ninety-nine years old, not more than 400 years after the Flood, so that Mr. Boscawen would have us believe in a Semitic race or tribe, and in Semitic cities, 1150 years before the Flood, and 1152 years before the firstborn of Shem, the father of the Semitic race, was born. He cannot mean an antediluvian tribe of Semites, for he speaks of Abraham as belonging to this tribe. The Victoria Institute have got the whole affair mixed up strangely.

* * *

My attention has been directed by several correspondents to a mistake—in reality a clerical error—respecting the Feast of Tabernacles in the article on the "Religion of Science," Knowledge, New Series, No. I., p. 2, col. 2. I seem to speak there of the *Fast* of Tabernacles, saying that "the enforced gloom of the Fast of Tabernacles (when not to fast was to incur death) corresponded with the mourning among Sabaistic nations as the sun neared the season of his second Passover, his transit across the equator from glory to gloom." In reality the first "fast" was a misprint for "feast," and the opening words should have run, "the enforced gloom of the day of atonement near the season of the Feast of Tabernacles." In an article on the "Origin of the Week," in my "Myths and Marvels of Astronomy," the correct relation between the observances of the first month (or month of the ascending passover) and those of the second month (or month of the descending passover) will be found correctly indicated.

* * *

The association between the two passovers, though the second lost the distinctive name which doubtless it had possessed among the Egyptians and Chaldæans, is too obvious to be overlooked. In the tenth day of the first month (following the vernal equinox as near as the moon would allow) every man was to take a lamb, and to keep it up until the fourteenth day of the same month. (The words "keep it up" must not be misunderstood in a festive sense). That day was the Passover interpreted by Moses in a special way (just as he interpreted the Sabbath rest in two special ways) to prevent the people from retaining the original idea, which was doubtless that of the passover of the sun ascending as Lord of the Year. On the fifteenth day began the Feast of Unleavened Bread which lasted for seven days, during which daily sacrifices (besides the burnt sacrifice offered each morning to the rising sun as Lord of the Day) were offered, "food of the offering made by fire, of a sweet savour unto the Lord" according to their strange anthropomorphic ideas of Deity. Now the seventh month bore the same relation to the autumnal equinox, or to the sun's descending passover, which the first month bore to the vernal. We find accordingly that on the tenth day of this seventh month, there was appointed a special day of mourning or affliction, the day of atonement. Just as the sacrifice to the rising sun as Lord of the Day was balanced by an evening sacrifice to the same orb when setting, so the special spring observances in regard to the sun ascending above the equator as Lord of the Year, were balanced by special autumn observances in the regard to the same orb when about to descend below the equator. And naturally the day consecrated to the descending passover of the sun god, though belonging to a season of thanksgiving for the fruits of the year, was made a day of affliction. An offering made by fire was presented to the Lord (to Jehovah by the Jews, but to the Sun God by the originators of the observance). And thus solemnly were the people adjured to afflict themselves (for atonement according to the law of Moses, but because of the dying of the sun's power according to the Chaldæans and earlier Egyptians)—"Ye shall do no manner of work in that same day; for it is a day of atonement, to make atonement for you before the Lord your God. For whatsoever soul it be that shall not be afflicted in that same day, he shall be cut off from his people. And

whatsoever soul it be that doeth any manner of work in that same day, that soul will I destroy from among his people. Ye shall do no manner of work; it is a statute for ever throughout your generations in all your dwellings. It shall be unto you a sabbath of solemn rest, and ye shall afflict your souls; in the ninth day of the month at even, from even unto even, shall ye keep your sabbath." Even until now the whole day of atonement is kept as a day of affliction by the Jews, a fast for twenty-four hours,—even by many Jews who are careless about all the other observances of Judaism. But while this day, marking the descent of the sun to the winter half of his career was a solemn fast and a day of mourning, the day of the Passover was a feast,—"This day shall be unto you for a memorial," said Moses, "and ye shall keep it a feast to the Lord; throughout your generations ye shall keep it a feast by an ordinance for ever."

* * *

It seems to me about as likely that the morning and evening sacrifices did not refer to the rising and setting sun, or the monthly sacrifices to the moon, as that originally the Feast of the Passover and the Fast of the Atonement did not refer to the ascension of the sun above the equator and his descent below it. I expect, however, that the day of the Passover was originally so fixed as to follow by three days (clear) the day of the actual crossing of the equator as determined by the astronomical priests of Egypt and Assyria, while in like manner the day of mourning preceded by three days (clear) the day of crossing the equator descendingly. The days of crossing, then, would be the tenth day of the first month and the fourteenth day of the seventh. We have traces of this in the killing of the Paschal Lamb on the tenth day of the first month, the day of the Passover, the fourteenth being immediately followed by the Feast of Unleavened Bread lasting for seven days beginning with the fifteenth; while the Day of Atonement on the tenth day of the seventh month was also followed by a feast of seven days beginning with the fifteenth day. This arrangement would leave an interval, from the killing of the Paschal Lamb to the beginning of the Feast of Tabernacles, almost exactly equal to the interval from the day of exactly twelve hours in spring to the day of exactly twelve hours in autumn.

* * *

It might be interesting to inquire how much farther the ideas originally connected with sun-worship penetrated into at least the ceremonial of the religions of to-day. It is tolerably well known that the earlier teachings of Christianity were associated with—some even have gone so far as to say that they had their origin in—the teachings of races farther east than Palestine, who at any rate in ceremonial retained the traditions of sun-worship. There is curious evidence on this point in a letter from the Emperor Hadrian to his brother-in-law Servianus, A.D. 134 in which he says, "The worshippers of Serapis" (the Sun-god) "are Christians, and those are consecrated to the god Serapis, who, I find, call themselves bishops of Christ." Of course, he must in some way have been misled by the resemblance between what he had heard about the birth, crucifixion, resurrection, and ascension of Christ, and what he knew about the birth of the Sun-god in Virgo,* his crossing (or Passover), recognised rising three days later (retained in the Jewish interval from the Passover to the beginning of the Feast of Unleavened Bread) and ascension to the glorious part of his—the Sun-god's—annual career. So also when he goes on to say "there is no presbyter of the Christians who is not either an astrologer or a soothsayer," he doubtless misinterpreted those matters of ceremonial observance which the Christians of his day retained from the ceremonial of sun-worship, on the same principle which led the early Jewish legislators to retain much of the same ceremonial, in fact the whole of its sacrificial portion, rather than disturb their people's minds by changes in unimportant matters, while they nevertheless zealously purified their actual teachings from all that they deemed inconsistent with the worship of one only God.

* * *

Mr. Wallace has I conceive done good service in calling attention to certain causes of depression in trade for which we are ourselves in large part responsible, instead of humouring that feeling which has led many to see no fault save in other nations. Of course there are some who will take exception to Mr. Wallace's arguments for no better reason than that being an eminent naturalist he has no right to form or express any opinion at all about trade or commerce. Others again may argue that because he has been deluded about certain spiritualistic matters over which many enthusiasts have gone astray, and about which some of the most learned have entertained strange superstitions, his opinion about national well-being can by no means be worth listening to. For my own part I hold all such objections as futile; and although as readers of Knowledge may have noticed I am by no means a believer in spiritualism (regarding many phenomena associated with it, however, as real, though natural) I can see no reason why either his skill as a naturalist should be regarded as a reason against his forming or expressing an opinion on that subject, nor on the other why because on that misleading and time-wasting subject he has erred he therefore should necessarily form erroneous opinions about trade depression, a matter which falls within the department of observational and indeed of experimental research.

* * *

A valued correspondent,—one of a rather large number who have discussed the question about Force and Energy, touched on in last month's "Gossip," notes that beside the more common misapprehensions into which Huxley, Romanes, Mivart, Hæckel, and others have fallen, being followed by many, there is one mistake which even special teachers of mechanics—as Tait and Balfour Stewart—have fallen into. They describe Kinetic Energy as Active, and Potential Energy as Passive. Now at a first view this seems right. A bullet flying from the mouth of a cannon or a stone flying swiftly through the air seems to tell us of very active energy; gas at high pressure or a compressed spring seems passive. Water at a height, in a reservoir, seems passive, water swiftly moving (upwards, downwards, or horizontally) seems active. But in reality it is the potential energy which is really active, the body which manifests kinetic energy is passive. The circumstance that a moving mass may at any moment communicate motion to some other body, or may even while it is moving be communicating motion, gene-

* In the Buddhist books we find the tradition that the Buddha was born of a virgin interpreted in like manner. In their story it is presented in its seemingly most monstrous form that the Buddha entered the side of the virgin in the form of a white elephant. But so soon as we note that the white elephant was the recognised Buddhist emblem of the sun, we see that the tradition belonged to sun-worship and is to be interpreted astronomically.

rating heat, or in some other way doing work, by no means makes its *motion* active. Such motion as it has, and is for the moment retaining, represents in reality passive energy. On the other hand, energy of position or potential energy is essentially active. The compressed spring is all the time exerting pressure. So is the compressed gas even though it be held compressed. Water in a reservoir is exerting active energy, as the strength which we have to give to the reservoir should show us. Weaken the walls by which the ever-struggling energy downwards is opposed, and that energy will show in a very obvious way whether it is active or passive. It may be argued that only so soon as it is thus free to show it is active can we recognise its activity; but in reality we might as reasonably argue that a prisoner pulling with all his strength at the bars of his prison is inactive, and that he is active only when the bars have yielded and he gets away.

* * *

IF one were asked to indicate one hundred of the vainest things men had ever attempted, one might after setting at the beginning the attempt itself, set next the attempt to indicate the hundred books which a man should read. Perhaps the absurdity of this attempt has been emphasised by the way in which persons of very special pursuits, tastes, aptitudes, and so forth, have indicated the hundred books they find best as best for all. Then the way in which the word book has been used in these lists adds to the absurdity. "Read Shakespeare and Cicero De Amicitiâ!"—one might as well say "Read the Bible and the episode of Glaucus and Diomed in the Iliad," or "read Darwin and Chaucer's 'Nonne Priestes Tale.'"

* * *

I WOULD suggest as a pendent to Sir J. Lubbock's list, the following:—

TWENTY ARTICLES OF CLOTHING "THAT WOULD SUFFICE FOR 'A PERSON'S' WHOLE STOCK."

1. A cocked hat.
2. Galligaskins.
3. A Fardingale.
4. Nankeen coat.
5. Mark-of-the-beast waistcoat.
6. Boots.
7. Button-hole nosegay.
8. Epaulettes.
9. A chasuble.
10. Trousers.
11. Set of shirts (frilled and ruffled).
12. Straps.
13. Collars.
14. Dalmatic.
15. Braces.
16. Neckties (various).
17. Waterproof overcoat.
18. Berlin gloves.
19. Kid slippers.
20. Furbelows.

For congruity and fitness for every "person" likely to use clothes at all this list seems fairly to match the other.

* * *

MR. LABOUCHERE, one with whom I find myself in nine cases out of ten most heartily agreeing, and to whom I always feel grateful for the fine example he sets in saying plainly what many feel but seem afraid to say, very properly launches ridicule at a certain foolish person (I forget his "highly respectable name") who finds atheism in the theory of eternal motion. But he goes on to express the opinion that inquiries into the laws of evolution, and into matters metaphysical, are alike a waste of time. Now, with regard to metaphysics I have nothing to say—which means of course that I might say a good deal, but nothing favourable. If, however, there ever was a matter which was of vital importance to the human race, it is the theory of evolution. If the gradual progress of this theory had produced no effects, one might understand doubt as to its importance. But on the contrary, this theory as it has gradually been established and as it has still more slowly been accepted, has entirely changed the ways and thoughts of men. Such modes of thought as we recognise in Mr. Labouchere and others would have no existence now, but for the struggle made by thinking men in the last few generations to establish the doctrine of evolution in its general form,—in other words to indicate the prevalence of law and the fertility of lawlessness no matter under what high and sacred names it may be disguised.

* * *

MR. A. FREDERICK HARRISON falls into a similar mistake (I cannot but think it such) in treating the doctrine of evolution as merely expressing a mode of thought, instead of being (and having shown itself in action) one of the most potent factors of modern progress. "Is it enough," he asks, "to have a vague sentimental impression of some mystical harmony of the Universe, some shadowy Optimism that somebody or something must have ordered these things for the best; to hold the mind secure in that bastard philosophy of evolution, which is merely another form of *laissez faire*—the selfish acquiescence in evil, I mean, in the lazy pretext that everything is working itself out in the long run, whether it be for the best, or the worst, is not our affair, and whatever it be, it is not for us to meddle. How can any intellectual opinion about the laws of this material world in any case inspire a moral and social devotion to active duty? Devotion to duty, under a deep and abiding sense of our moral and social responsibility, needs to call in all the powers of our complex nature, all the secret springs of character and motive. We must appeal to men's sympathy as well as knowledge; to enthusiasm as well as convictions; to habits as well as to culture. Ambition, envy, covetousness, disorder, injustice, vanity, and mad recklessness, are passions so common in our social organisation and so frightfully dangerous to its peace, that we need every resource that we can get to curb and guide the movement of public life."

* * *

"WHEN a real *human* religion," he proceeds, "has established its kingdom on earth—a religion with a code of earthly duty,—and a scheme to kindle earthly emotions and enthusiasms, all grouped round and issuing out of our sense of fellowship in humanity, and our part in the welfare of humanity—men will be trained from childhood to look on their great civic duties as amongst the noblest of all human obligations; public opinion will be elevated by the ever-present sense that a public function is a religious duty; the meanness of personal ambition will be confronted with a sense of the mighty and organic whole with which we are incorporate, or which we are defying. Sloth and selfishness in our public duties will be treason against humanity as well as disloyalty to our fellow-citizens. And as we debate and vote upon the questions of the hour, it will be ever present to our memory that our vote, be it wise or foolish, selfish or patriotic, is so far as in us lies, deciding the future of that greatest Power of which we have certain evidence on earth—the course of Human Civilisation, and is forming some infinitesimal atom in the life of Humanity."

* * *

ALL this is in reality, though he does not see it, the expression of what must actually result, what actually has already in part resulted, from the influence of the doctrine of evolution in its relation to man. When men generally accept the doctrine of evolution, they will

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view human duties as Mr. Harrison would have them, and recognise a religion of humanity (by no means like the Positivists, however, in implying any enthusiastic admiration of humanity as it at present exists) depending on the sense that each one of us has power and will by which to aid, in greater or less degree, the progress of our race towards better things.

* * *

It may be worth while, perhaps, to mention that on Feb. 14 I deliver a discourse on "The Past of Religion" at South Place Chapel, Finsbury; and another on "The Future of Religion," on Feb. 21, at a quarter-past eleven, morning.

New Books to be Read—and Why.

An Introduction to Practical Bacteriology. By Edgar M. Crookshank, M.B., F.R.C.S. (London: H. K. Lewis. 1886.)—Because the germ-theory of disease is now emphatically on its trial, and the ultimate decision of the pathologist must be based upon the result of experiments, the mode of making which is given in the most minute detail in Mr. Crookshank's excellent book. He has really produced a kind of small encyclopædia of the subject, in which the incipient student of bacteriology may learn everything about the apparatus needed for the prosecution of his researches, and the best and most effective methods of employing it. He is further taught the use of the microscope for the same purpose, and is instructed how to make preparations for viewing with it. The cultivation of the bacteria is next explained, and the methods of inoculation with them, and the examination of bodies affected by them given. Finally, a classification and description of those species of bacteria recognised as distinct, and an Appendix of varied information conclude the work. It is long since we have seen anything more beautiful or life-like than the majority of the numerous illustrations which adorn the volume before us.

Magnetism and Electricity. By H. C. Tarn, M.C.P. (London: W. & R. Chambers. 1886.)—Because, while professedly written to enable students to pass in the first class in the elementary examinations at South Kensington, Mr. Tarn's small volume is commendably free from "cram," and places the leading facts of magnetism and electricity in an agreeable and apprehensible light. The constant reference to experiment, and the very numerous ones described and illustrated, will surely serve to render the work attractive to the beginner.

The Quickest Guide to Breakfast, Dinner, and Supper. By Aunt Gertrude. (London: T. Fisher Unwin.)—Because it contains *menus*, and *menus* alone, and supplies just the information needed by the housekeeper but too often driven to her wits' end for some change in a dreary and very circumscribed round of bills of fare. A *précis* of the way of cooking every one of the hundreds of dishes catalogued by "Aunt Gertrude" is appended to it.

Report of the East Anglian Earthquake of April 22nd, 1884. By Raphael Meldola, F.C.S., &c., and William White, F.E.S. (London: Macmillan & Co. 1885.)—Because it gives a practically exhaustive account of a convulsion with which we are happily unfamiliar in England; tracing its phenomena, results, area of disturbance, dependence upon geological structure, &c., in a form calculated to render the ordinary reader slightly less confident perhaps than he may have hitherto been, that the soil of Great Britian is of absolute necessity *terra firma*. The astronomer will read with interest on p. 216, *et seq.*, of the alleged shifting of a large equatoreal, weighing something like a ton, by the passage of the earthquake wave.

How We're "Done"; or, Our Little "Do"'s. By One who Knows Them. (London: Wyman & Sons. 1866.)—Because, at all events, it is amusing, and, under the guise of persiflage and "chaff," tells a large number of home truths, which it must be useful for every one to know and to remember. Its author's taste in places, is, however, of a questionable description; for while the chapters on quack medicines, music, picture-dealing, and the British workman are as good as they are true, the sneers at our Royal Family and the essay on the Church and clergy seem to us to be leavened with a spite as needless as it is unjust.

The Looking-glass; a true History of the Early Years of an Artist. By Theophilus Marcliffe. (London: Bemrose & Sons. 1885.)—Because it is a facsimile reprint of the Biography of Mulready, the well-known Royal Academician, which was written by the notorious William Godwin under the *nom-de-plume* which appears on the title-page. Paper, print, and illustrations are all admirably reproduced, and give a capital notion of the style and appearance of the literature which delighted our grandfathers in their school-days.

Chemical Student's Manual. By H. L. Buckeridge, F.C.S., &c. (London: Thomas Murby.)—Because it will be found valuable by the student who is undergoing a systematic course of instruction in chemistry, whether in the form of lectures or of laboratory practice. It takes the form of a series of notes of all points necessary to be thoroughly apprehended and remembered, is well illustrated, and may be commended.

The Prospector's Handbook. By J. W. Anderson, M.A., F.R.G.S. (London: Crosby Lockwood & Co. 1886.)—Because its author, having himself travelled through the rich mineral fields of New Zealand, New Caledonia, New Mexico, and Colorado, knows from actual personal experience the difficulties which beset the miner or prospector in his search for metals and ores in a new country, and is hence in a position to speak *ex cathedrâ* as to the best and most effectual methods of discovering and obtaining them.

The Dyeing of Textile Fabrics. By J. J. Hummel, F.C.S. (London: Cassell & Co. 1885.)—Because it forms a concise little cyclopædia of the art of dyeing, and expounds in a simple manner the latest processes and methods in it.

Those who may wish to have their previous ideas subverted, and to be generally set to rights intellectually, may (if they choose) read *Hygienic Medicine*, by T. R. Allinson, L.R.C.P. (London: Pitman, 1886), who "runs a-muk" at the teachings of that College of which he proclaims himself a Licentiate, and proposes to regenerate mankind by limiting them to vegetable food, like the beasts of the field. Also *The Light of Life*, edited by Joseph John Kain (London: Wyman & Sons, 1885), in which vaccination is denounced, a new theory of development advanced, and so on. We have also before us *Notabilia of Greek Syntax*, by Rev. F. W. Aveling, M.A., B.Sc. (London: Relfe Brothers); Nos. 1, 2, 3, and 4 of *The New Explanatory Reader* (London: Moffatt & Paige). *The Jurors' Report of the Aëronautical Exhibition of* 1885 (Greenwich: H. Richardson), and Vols. IX. and X. of Mrs. Horace Dobell's *Watches of the Night* (London: Remington & Co.).

Our Whist Column.

GAME I.

THE HANDS.

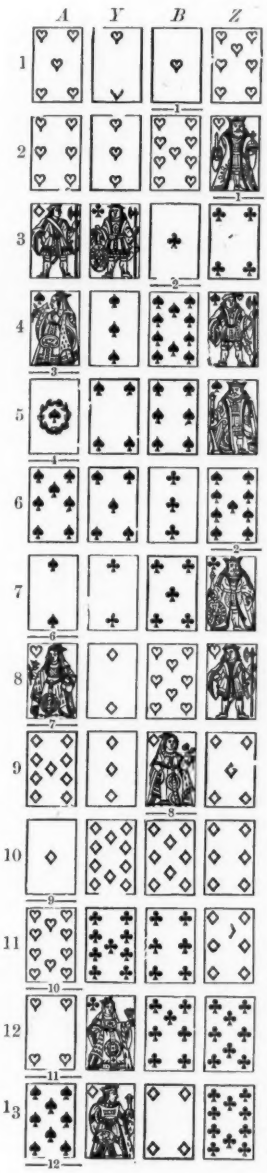
B { S (*trumps*). 10, 6. H. A, 9, 8. D. Q, 8, 4. C. A, 6, 7, 5 3. }

Y { S (*trumps*). 5, 4, 3 H. 3, 2. D. K, 10, 3, 2. C. Q, Kn, 9, 2.

K, Kn, 9. K, Kn, 7. 7, 6, 5. K, 10 8, 4. } *Z*

A { S (*trumps*). A, Q, 8, 7, 2. H. Q, 10, 6, 5, 4. D. A, Kn, 9. C. Nill. }

Score :—Love all.



NOTES TO GAME 1.

NOTE.—Card underlined takes trick, and card next below leads next.

1. With five of a suit and five trumps, *A* properly leads his suit and the penultimate card, which he would show upon the return if *B* had Ace, King, or the fall of the cards rendered it advisable.

2. It is clear from the return that *B* has not more than three. *A* conceals the penultimate, and from the fall of the cards the position of Heart Four is now uncertain. It may be with *B* or *Y*.

3. *A*, by the discard of Diamond Knight, must certainly be calling.

4. *B* is equal to the occasion, and leads through the King.

5. *Z* here properly plays a false card. By playing the Nine he would still be keeping the turn-up trump, thus making the position too easy for *A*.

6. But as *A* has the Seven and the Eight he is in no difficulty, even if *Y* should hold the two remaining trumps.

7. *Z* proceeds to force *A*; one trump remains in.

8. *A* is obliged to proceed with Heart Queen; the Knave might be guarded in the hand of either *Y* or *Z*.

9. *A*, who has nothing to lose, and is playing for five by cards, leads Diamond Nine. *Y* ought, at all risks, to play Diamond King. The fall of the cards ought to have made it clear to him that the remaining Hearts were with *A*. If *Z* had Diamond Ace it was immaterial. It is in such a position that skill tells. The rest of the hand plays itself.

Our Chess Column.

BY MEPHISTO.

AN IMPROVED SCALE OF ODDS AT CHESS.

IT is, indeed, an anomaly that, until now, we should have retained the same hackneyed scale of odds in use ever since the good old times. These odds are very unsatisfactory, as everybody knows who has ever taken part in a Handicap Chess Tournament. The objections against the old scale of odds are many. Theoretically, there is a fundamental defect in the scale. According to this, A gives B Pawn and one move, and to C Pawn and two moves; whereas B has to give C Pawn and one move. We maintain that B is unduly handicapped, the reason being that B ought to give to C merely the difference between Pawn and move and Pawn and two moves; but B actually gives C more than that.

The question what would be a fair equivalent of odds for B to give to C is easily answered. If—making allowance for the importance of the move—we substitute two moves for the one move difference between the odds of Pawn and move and Pawn and two moves, then we have fairly met the case. It will be admitted that a player giving the odds of the first two moves experiences a difficulty in the opening and development of his game. Now, as the odds of Pawn and two moves are merely Pawn and one move plus difficulty, therefore the odds of the first two moves, which are somewhat difficult to meet, are equal to the difference between the odds of Pawn and one move, and Pawn and two moves, so that whilst A gives B Pawn and move, and to C Pawn and two moves, B ought only to give the first two moves to C.

Theoretically nothing whatever justifies B to give to C the substantial advantage of a Pawn. Practically the result of experience is, if possible, still more conclusive. In most chess circles and clubs there will be found players whose play indicates that they are almost too good to receive Pawn and two moves, yet they are not advanced into the (so called) second, *i. e.*, the Pawn and move class, because in most instances they could not yield the odds of Pawn and one move successfully to the lower class. This fact clearly shows that there is something wrong, and leaves no doubt as to where the fault lies.

Most pronounced of any case is, secondly, that of the first class players. In this class there are now-a-days but very few players indeed whose chess talents satisfy all the conditions upon which a player in modern times is pronounced a first class player. But there are many players who undoubtedly possess great genius and ability for the game, who are mostly too strong to receive the odds of Pawn and one move from the first class, also too strong to play on level terms with Pawn and move players, but they are not strong enough either to play successfully against first class players on level terms, nor against the second class at Pawn and move.

Our proposition is to create a new class of odds, which would not only meet the case of the third-class players and that of the first and second-class players, but it would also effect an improvement in the lower classes, as we propose to create not only a fresh class between the first and second, but also two new classes between the Knight-classes and Rook-classes, the effect of which will be to bring about a more equitable and uniform distribution of odds, enabling a player to rise by gradual and easy stages.

Our proposition is that

First class give to second class the *first two moves.*

„	„	third	„	*Pawn and move.*
„	„	fourth	„	*Pawn and two moves.*
„	„	fifth	„	*Knight.*
„	„	sixth	„	*Knight and the move.*
„	„	seventh	„	*Rook.*
„	„	eighth	„	*Rook and the move.*

In references to the Knight and Rook classes, we think the case is on all fours with that of Pawn and move and Pawn and two moves. The difference between receiving the Knight or Rook with or without the move is a considerable increase of difficulty which is fairly balanced by an equivalent of two moves, which the player receiving the Knight without the move has to give to the player receiving the Knight and the move. We recommend our scale of odds to the favourable consideration of all concerned, and we may mention that this improved scale has been adopted in an important handicap

tournament which is now in progress at the well-known City chess resort at Purssell's, in Cornhill.

To show the distribution of these odds for all classes we give the following table, which explains itself:—

SCALE OF ODDS.

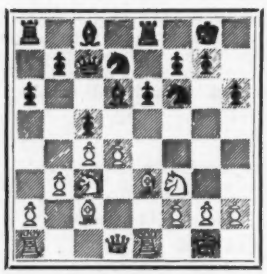
	Two moves.	Pawn and move.	Pawn and two moves.	Knight.	Knight and move.	Rook.	Rook and move.
Class 1 gives to Class	2	3	4	5	6	7	8
„ 2 „ „	3	4	5	6	7	8	
„ 3 „ „	4	5	6	7	8		
„ 4 „ „	5	6	7	8			
„ 5 „ „	6	7	8				
„ 6 „ „	7	8					
„ 7 „ „	8						

By testing this scale of odds in different directions, it will be found that in spite of the many improvements, yet in the main the class of odds are altered but very slightly. We give a few instances:—

A Pawn and two player (class 4) gives Pawn and two moves to a Rook player (class 7), the same as he always did. A Knight player (class 5) gives Pawn and move to a Rook player (class 7). A Pawn and move player gives Pawn and two moves to the weaker division of the Knight class only; but he gives a Kt to the Rook class as before. The first-class player gives to all classes the same odds as before, materially improved upon by the interposition of three new classes—namely, the 2nd, 6th, and 8th.

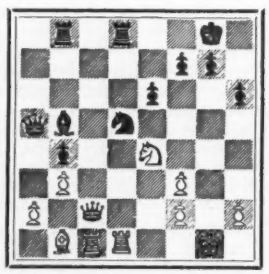
The following game was played on January 21 in the Handicap Tournament at Purssell's Chess-rooms. It is a good example of a game played at the odds of two moves:—

White. A. G. Guest.	Black. J. Gunsberg.
1. Kt to KB3	
2. P to Q4 (*a*)	P to Q4
3. P to B4	P to K3
4. P to K3	Kt to KB3
5. B to Q3	P to B3
6. Castles	B to Q3
7. Kt to B3	QKt to Q2
8. P to K4 (*b*)	P × KP
9. B × P	P to KR3
10. R to Ksq (*c*)	Castles
11. B to B2	R to Ksq
12. Kt to K5	P to QB4 !
13. Kt to B3 (*d*)	P to R3
14. B to K3	Q to B2
15. P to QKt3 (*e*)	



15.	P × P
16. Q × P (*f*)	Kt to K4
17. Q to R4 (*g*)	Kt × Kt(ch)
18. P × Kt	B to K4 (*h*)
19. B to Q4	B × B

White. A. G. Guest.	Black. J. Gunsberg.
20. Q × B	R to Qsq
21. Q to K3	P to QKt4 (*i*)
22. P × P	P × P
23. B to K4	R to Kt sq
24. QR to Bsq	Q to R4
25. KR to Qsq	B to Q2
26. B to Kt sq	P to Kt5
27. Kt to K4	Kt to Q4
28. Q to Q3 (*j*)	B to Kt4
29. Q to B2	



29.	P to B4 (*k*)
30. Kt to B5 (*l*)	Kt to KB5(*m*)
31. K to Rsq (*n*)	B to K7 !
32. R to Ksq	Q to Rsq !
33. Kt to K4 (*o*)	B × P(ch)
34. K to Kt sq	P × Kt
35. Q to B4	R to Q4
36. B × P	R to Kt4(ch)
37. K to Bsq	B to Kt7(ch)
Resigns.	

NOTES.

(*a*) This brings about Zukertort's Queen's Opening, White being a move ahead. We think, however, that White would do better to play 1. P to K4 and Q4, preventing a regular Opening, and compelling Black to play a defence resembling the French.

(*b*) This is proper play now; but it tends to show that it must be better to play P to K4 on the first move, instead of losing time by playing first P to K3, and then P to K4.

(*c*) With a view to advancing P to Q5.

(*d*) A serious loss of time. White might have simplified matters by 13. Kt × Kt, B × Kt. 14. P × P, B × BP. 15. B to K3, &c. White's object in playing his Kt back to B3 was to keep Black's QB blocked up.

(*e*) Compromising his position on the Q side.

(*f*) His best, for if 16. B × P, P to K4. 17. B to K3, P to K5, &c., winning the KRP.

(*g*) White preferred this move to retiring this Kt., as he evidently relies on the favourable position of his QB for attacking Black.

(*h*) White threatened B × P.

(*i*) An attempt to bring the QB into play.

(*j*) White's intention is obviously to get a chance of playing his Q to R7, even at a sacrifice; for that reason Black had to be very exact in his moves.

(*k*) The only way of counteracting White's designs. If Kt to B5, then Kt to B6(ch) wins. R to Bsq would also be fatal. P to B4, however, required proper examination, for there was the possibility of White attacking the weakened KP successfully, or taking it off even if protected, followed by Q × P.

(*l*) Playing as indicated above. But we think Kt to Kt3 would have been more defensive, as it guards the square on K7, which Black is endeavouring to reach with his Kt.

(*m*) This move defends the KP, for if 31. Kt × P, Kt × Kt. 32. Q × P, Kt, Bsq safely. The move is also very attacking, threatening Kt to K7. Again, if White plays R × R, the Black Q retakes, threatening to mate as follows:—31. R × R(ch), Q × R. 32. K to Rsq, Q to Kt4. 33. R to KKt sq, Q to R4, followed by B to B3, &c.

(*n*) This loses right off. 31. R to Ksq was best.

(*o*) White has no other defence against Black's last move.

STEINITZ *v.* ZUKERTORT.

The first part of this match is now concluded, and resulted in a decisive victory for Zukertort, who won four games to one.

The following vigorously-played game is the first of the match, commenced on Jan. 11, at New York:—

White. Zukertort.	Black. Steinitz.	White. Zukertort.	Black. Steinitz.
1. P to Q4	P to Q4	24. K to Ksq	Kt to Kt5
2. P to QB4	P to QB3	25. B × Kt	B × B
3. P to K3	B to KB4	26. Kt to K2	Q to K2
4. Kt to QB3	P to K3	27. Kt to KB4	R to R3
5. Kt to KB3	Kt to Q2	28. B to B3	P to Kt4
6. P to QR3	B to Q3	29. Kt to K2	R to B3
7. P to B5	B to B2	30. Q to Kt2	R to B6
8. P to QKt4	P to K4	31. Kt to KBsq	R to QKt sq
9. B to K2	KKt to B3	32. K to Q2	P to B4
10. B to Kt2	P to K5	33. P to R5(?)	P to B5
11. Kt to Q2	P to KR4	34. R to KRsq	Q to B2
12. P to KR3	Kt to Bsq	35. QR to Ksq	P × P(ch)
13. P to QR4 (?)	Kt to Kt3	36. Kt × P	R to B7
14. P to Kt5	Kt to R5	37. Q × R	Q × Q
15. P to Kt3	Kt to Kt7(ch)	38. Kt × B	B to B5(ch)
16. K to Bsq	Kt × P(ch)	39. K to B2	P × Kt
17. P × Kt	B × KtP	40. B to Q2	P to K6
18. K to Kt2	B to B2	41. B to Bsq	Q to Kt7
19. Q to KKt sq	R to R3	42. K to B3	K to Q2
20. K to Bsq	R to Kt3	43. R to R7(ch)	K to K3
21. Q to B2	Q to Q2	44. R to R6(ch)	K to B4
22. P × P	P × P	45. B × P	B × B
23. KR to Kt sq	B × P(ch)	46. R to Bsq(ch)	B to B5

White resigns.

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